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THE

WISDOM of GOD

Manifested in the

WORKS

OF THE

CREATION.

In TWO PARTS.

VIZ.

The heavenly BODIES, ELEMENTS, METEORS, Fossils, Vegetables, Animals, (Beasts, Birds, Fishes, and Insects) more particularly in the Body of the Earth, its Figure, Motion, and Consistency; and in the admirable Structure of the Bodies of Man and other Animals; as also in their Generation, *&c.* With Answers to some Objections.

By *JOHN RAY*, late FELLOW of the ROYAL SOCIETY.

The TENTH EDITION, Corrected.

LONDON:

Printed by WILLIAM INNYS and RICHARD MANBY, Printers to the *Royal Society*, at the West-End of St. *Paul's*.

M DCC XXXV.

TO THE

Much honour'd and truly religious

LADY,

THE

Lady LETTICE WENDY,

OF

Wendy in *Cambridgeſhire.*

MADAM,

TWO or three Reaſons induce me to preſent this Diſcourſe to your Ladyſhip, and to make choice of you for its Patroneſs. *Firſt*, Becauſe I owe it to the Liberality of your honour'd Brother that I have this Leiſure to write any thing. *Secondly*, Becauſe alſo your many and ſignal Favours, ſeeing I am not in a Capacity to requite them, ſeem to exact from me at leaſt a

publick Acknowledgment, which ſuch a Dedication gives me an Opportunity to make. *Thirdly*, Becauſe of ſuch kind of Writings I know not where to chuſe a more able Judge or more candid Reader. I am ſenſible that you do ſo much abhor any thing that looks like Flattery, that out of an Exceſs of Modeſty, you cannot patiently bear the hearing of your own juſt Commendations; and therefore ſhould I enlarge upon that Subject, I know I ſhould have but little Thanks for my Pains.

Indeed you have much better Motives to do well than the Praiſe of Men, the Favour of God, Peace of Conſcience, the Hope and Expectation of a future Reward of *eternal Happineſs*; and therefore I had rather write of you to others, to provoke them to imitate ſo excellent an Example, than to your ſelf, to encourage you in your Chriſtian Courſe, and to fortify you in your athletick Conflicts with the greateſt of temporal Evils, bodily Pain and Anguiſh; tho' I do not know why you ſhould reject any Conſideration that may conduce to ſupport you under ſo heavy Preſſures, and of ſo long Continuance; of which to ingenious Natures, true Honour, that is, the current Teſtimony and Approbation of good Men, is not the meaneſt. No leſs Man than St. *Auguſtin* was doubtful whether the Extremity of bodily Pain were not the greateſt Evil that human Nature was capable of ſuffering; *Nay* (ſaith he) *I was ſometimes compell'd to conſent to* Cornelius Celſus, *that it was ſo; neither did his*

Reaſons ſeem to me abſurd, we being compounded of two Parts, Soul and Body, of which the firſt is the better, the latter the worſer; the greateſt Good muſt be the beſt thing belonging to the better Part, that is, Wiſdom; and the greateſt Evil the worſt thing incident to the worſer Part (the Body) that is, Pain. Now, tho' I know not whether this Reaſon be firm and concluſive, yet I am of accord with him, that of all the Evils we are ſenſible of in this World it is the ſoreſt, the moſt reſolute Patience being baffled and proſtrated by a fierce and laſting Paroxyſm of the Gout, or Stone, or Cholick, and compell'd to *yield to its furious Inſults*, and confeſs itſelf vanquiſh'd, the Soul being unable to divert, or to do any thing elſe but pore upon the Pain; and therefore thoſe Stoical Vaunts of their wiſe Man's being happy in *Phalaris*'s Bull, I utterly reject and explode, as vain Rhodomontades and chimerical Figments, for that there never was ſuch a wiſe Man among them, or indeed could be; yet do I not ſay that the Patience of a good Man can be ſo far conquer'd by the ſharpeſt and ſevereſt Torments as to be compell'd to deny or blaſpheme *God* or his *Religion*, yea, or ſo much as to complain of his Injuſtice; tho' perchance he may be brought with *Job* to curſe his Day, yet not curſe his God, as his Wife tempted him to do.

Now that the great Ἀγωνοθέτης and Βραβεύτης, the moſt juſt Judge and Rewarder, would be pleas'd ſo to qualify and mitigate your Sufferings,

as

as not to exceed the *Meaſure of your Strength and Patience*, or elſe arm you with ſuch an high degree of Chriſtian Fortitude, as to be able to grapple with the moſt Extreme; and when you have finiſh'd your Courſe in this World, grant you a placid and eaſy Paſſage out of it, and dignify you as one of his Victors, with a Crown of eternal Glory and Felicity, is the Prayer of,

MADAM,

Your LADYSHIP's

Moſt devoted in all Service,

JOHN RAY.

THE

PREFACE.

IN all Ages wherein Learning hath flouriſh'd, Complaint hath been made of the Itch of Writing, and the Multitude of worthleſs Books wherewith importunate Scriblers have peſter'd the World: Scribimus indocti doctique: *And* —— Tenet inſanabile multos ſcribendi cacoethes. *I am ſenſible that this Tractate may likely incur the Cenſure of a ſuperfluous Piece, and myſelf the Blame of giving the Reader unneceſſary Trouble, there having been ſo much ſo well written of this Subject by the moſt learned Men of our Time,* *Dr.* Moore, *Dr.* Cudworth, *Dr.* Stillingfleet, *late Biſhop of* Worceſter, *Dr.* Parker, *late of* Oxon; *and, to name no more, the honourable* Robert Boyle *Eſq; ſo that it will need ſome Apology.* Firſt *therefore in Excuſe of it I plead, that there are in it ſome Conſiderations new and untouch'd by others; wherein if I be miſtaken, I alledge,* Secondly, *That the*

the Manner of Delivery and Expreſſion may be more ſuitable to ſome Mens Apprehenſion, and facil to their Underſtandings. If that will not hold, I pretend, Thirdly, *That all the Particulars contain'd in this Book cannot be found in any one Piece known to me, but lie ſcatter'd and diſpers'd in many, and ſo this may ſerve to relieve thoſe faſtidious Readers that are not willing to take the Pains to ſearch them out; and poſſibly there may be ſome whoſe Ability (whatever their Induſtry might be) will not ſerve them to purchaſe, nor their Opportunity to borrow thoſe Books, who yet may ſpare Money enough to buy ſo inconſiderable a Trifle. If none of theſe Excuſes ſuffice to acquit me of Blame, and remove all Prejudice, I have two farther Reaſons to offer, which I think will reach home, and juſtify this Undertaking.* First, *That all Men who preſume to write, at leaſt whoſe Writings the Printers will venture to publiſh, are of ſome Note in the World; and where they do, or have liv'd and convers'd, have ſome Sphere of Friends and Acquaintance, that know and eſteem them, who it is likely will buy any Book they ſhall write for the Author's Sake, who otherwiſe would have read none of that Subject, tho' ten times better; and ſo the Book, however inferior to what have been already publiſh'd, may happen to do much Good.* Secondly, *By Virtue of my Function I ſuſpect my ſelf to be oblig'd to write ſomething in Divinity, having written ſo much on other Subjects; for being not permitted to ſerve the Church with my Tongue in Preaching, I know not but it may be my Duty to ſerve it with my Hand*

Hand by Writing: And I have made choice of this Subject, as thinking myself best qualify'd to treat of it. If what I have now written shall find so favourable Acceptance as to encourage me to proceed, God granting Life and Health the Reader may expect more; if otherwise, I must be content to be laid aside as useless, and satisfy myself in having made this Experiment.

As for this Discourse, I have been careful to admit nothing for Matter of Fact or Experiment but what is undoubtedly true, lest I should build upon a sandy and ruinous Foundation; and by the Admixture of what is false, render that which is true suspicious.

I might have added many more Particulars; nay, my Text warrants me to run over all the visible Works of God in particular, and to trace the Footsteps of his Wisdom in the Composition, Order, Harmony, and Uses of every one of them, as well as of those that I have selected. But, First, *this would be a Task far transcending my Skill and Abilities; nay, the joint Skill and Endeavours of all Men now living, or that shall live after a thousand Ages, should the World last so long.* For no Man can find out the Work that God maketh from the Beginning to the End, *Eccles.* iii. 11. Secondly, *I was willing to consult the Infirmity of the Reader, or indeed of Mankind in general; which, after a short Confinement to one sort of Dish, is apt to loath it, tho' never so wholsome, and which at first was most pleasant and acceptable; and so to moderate my Discourse, as to make an end of writing before I might presume he should be quite tir'd with reading.*

I shall now add a Word or two concerning the Usefulness of the Argument, or Matter of this Discourse, and the reason I had to make choice of it, besides what I have already offer'd.

First, *The Belief of a Deity being the Foundation of all Religion (Religion being nothing but a devout worshipping of God, or an Inclination of Mind to serve and worship him)* for he that cometh to God must believe that he is God, *it is a Matter of the highest Concernment to be firmly settled and establish'd in a full Persuasion of this main Point; now this must be demonstrated by Arguments drawn from the Light of Nature and Works of the Creation; for as all other Sciences, so Divinity, proves not, but supposes its Subjects, taking it for granted, that by natural Light Men are sufficiently convinc'd of the Being of a Deity; there are indeed supernatural Demonstrations of this fundamental Truth, but not common to all Persons or Times, and so liable to Cavil and Exception by atheistical Persons, as inward Illuminations of Mind, a Spirit of Prophecy, and foretelling future Contingents, illustrious Miracles, and the like; but these Proofs, taken from Effects and Operations, expos'd to every Man's View, not to be deny'd or question'd by any, are most effectual to convince all that deny or doubt of it; neither are they only convictive of the greatest and subtlest Adversaries, but intelligible also to the meanest Capacities; for you may hear illiterate Persons, of the lowest Rank of the Commonalty, affirming, that they need no Proof of the Being of a God, for that every Pile of Grass or Ear of Corn sufficiently proves that; for, say they, all the Men of the World cannot make*

such a thing as one of these; and if they cannot do it, who can or did make it but God? To tell them that it made itself, or sprung up by chance, would be as ridiculous as to tell the greatest Philosopher so.

Secondly, *The Particulars of this Discourse serve not only to demonstrate the Being of a Deity, but also to illustrate some of his principal Attributes; as, namely, his infinite Power and Wisdom; the vast Multitude of Creatures, and those not only small, but immensely great, the Sun and Moon, and all the heavenly Host, are Effects and Proofs of his Almighty Power.* The Heavens declare the Glory of God, and the Firmament sheweth his Handy-work, *Psal.* xix. 1. *The admirable Contrivance of all and each of them, the adapting all the Parts of Animals to their several Uses, the Provision that is made for their Sustenance, which is often taken notice of in Scripture.* Psal. cxlv. 15, 16. The Eyes of all wait upon thee: thou givest them their meat in due season. Thou openest thy hand, and satisfiest the desire of every living thing. *Matth.* vi. 26. Behold the fowls of the air, for they sow not, neither do they reap, nor gather into barns, yet your heavenly Father feedeth them. *Psal.* cxlvii. 9. He giveth to the beast his food, and to the young Ravens when they cry. *And lastly, their mutual Subserviency to each other, and unanimous conspiring to promote and carry on the Publick Good, are evident Demonstrations of his Sovereign Wisdom.*

Lastly, *They serve to stir up and increase in us the Affections and Habits of Admiration, Humility, and Gratitude.* *Psal.* viii. 3. When I consider the heavens, the work of thy fingers, the moon

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[*Note*, That by the Works of the Creation in the Title, I mean the Works created by God at firſt, and by him conſerv'd to this Day in the ſame State and Condition in which they were at firſt made; for *Conſervation* (according to the *Judgment both of Philoſophers and Divines)* is a *continu'd Creation.*]

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THE

WISDOM of GOD

Manifested in the

WORKS

OF THE

CREATION.

PART. I.

PSAL. civ. 24.

How manifold are thy Works, O Lord!
In Wisdom hast thou made them all.

IN these Words are two Clauses; in the first whereof the Psalmist admires the Multitude of God's Works, *How manifold are thy Works, O Lord!* In the second he celebrates his Wisdom in the Creation of them; *In Wisdom hast thou made them all.*

Of the first of these I shall say little, only briefly run over the Works of this visible World, and give some guess at the Number of them; whence it will appear, That upon this Account they will deserve Admiration, the Number of them being uninvestigable by us, and so affording us a demonstrative Proof of the unlimited Extent of the Creator's Skill, and the Fœcundity of his Wisdom and Power. That the Number of corporeal Creatures is unmeasurably great, and known only to the Creator himself, may thus probably be collected: First of all, The Number of fixed Stars is on all Hands acknowledg'd to be next to infinite: Secondly, every fix'd Star, in the now-receiv'd *Hypothesis*, is a Sun, or Sun-like Body, and in like Manner incircled with a *Chorus* of Planets moving about it; for the *Fix'd Stars* are not all placed in one and the same concave Spherical *Superficies*, and equidistant from us, as they seem to be, but are variously and disorderly situate, some nearer, some further off, just like Trees in a Wood or Forest, as *Gassendus* exemplifies them. And as in a Wood, tho' the Trees grow never so irregularly, yet the Eye of the Spectator, wherever plac'd, or whithersoever remov'd, describes still a Circle of Trees: So would it in like Manner whenever it were in the Forest of Stars, describe a Spherical *Superficies* about it. Thirdly, Each of these Planets is in all likelihood furnished with as great Variety of corporeal Creatures, animate and inanimate, as the Earth is, and all as different

in Nature as they are in Place from the Terreſtrial, and from each other. Whence it will follow, That theſe muſt be much more infinite than the Stars; I do not mean abſolutely according to Philoſophick Exactneſs infinite, but only infinite or innumerable as to us, or their Number prodigiouſly great.

That the fix'd Stars are innumerable, may thus be made out: Thoſe viſible to the naked Eye are by the leaſt Account acknowledg'd to be above a Thouſand, excluding thoſe towards the *South* Pole, which are not viſible in our Horizon: Beſides theſe, there have been incomparably more detected and brought to Light by the Teleſcopes; the Milky-way being found to be (as was formerly conjectur'd) nothing but great Companies or Swarms of Minute Stars ſingly inviſible, but by reaſon of their Proximity mingling and confounding their Lights, and appearing like lucid Clouds. And it is likely that, had we more perfect Teleſcopes, many Thouſands more might be diſcovered; and yet, after all, an incredible Multitude remaim, by reaſon of their immenſe Diſtance beyond all Ken, by the beſt Teleſcopes that could poſſibly be invented or poliſh'd by the Wit and Hand of an Angel: For if the World be (as *Des Cartes* would have it) indefinitely extended, that is, ſo far as no human Intellect can fancy any Bound of it; then what we ſee, or can come to ſee, muſt be the leaſt Part of what is undiſcoverable by us, the whole Univerſe extending a thouſand times farther beyond the

utmoſt Stars we can poſſibly deſcry, than thoſe be diſtant from the Earth we live upon. This *Hypotheſis* of the *Fix'd Stars* being ſo many *Suns*, *&c.* ſeems more agreeable to the Divine Greatneſs and Magnificence. But that which induces me much to doubt of the Magnitude of the Univerſe, and immenſe Diſtance of the *Fix'd Stars*, is the ſtupendous *Phænomena* of *Comets*, their ſudden Acceſſion, or Appearance in full Magnitude, the Length of their Tails, and Swiftneſs of their Motion, and gradual Diminution of Bulk and Motion, 'till at laſt they diſappear. That the Univerſe is indefinitely extended, *des Cartes*, upon a falſe Ground, (that the *formal Ratio* of a Body was nothing but Extenſion into Length, Breadth, and Profundity, or having *partes extra partes*, and that *Body* and *Space* were ſynonymous Terms) aſſerted; it may as well be limited this Way, as in the old *Hypotheſis*, which places the *Fix'd Stars* in the ſame Spherical *Superficies*; according to which (old *Hypotheſis*) they may alſo be demonſtrated by the ſame *Mediums* to be innumerable, only inſtead of their Diſtance ſubſtituting their Smalneſs for the Reaſon of their Inviſibility.

But leaving the *Cæleſtial* Bodies, I come now to the *Terreſtrial*; which are either *inanimate*, or *animate*. The *inanimate* are the *Elements*, *Meteors*, and *Foſſils* of all Sorts, at the Number of which laſt I cannot give any probable Gueſs: But if the Rule, which ſome conſiderate Philoſophers deliver, holds good, *viz.*

how much more imperfect any *Genus*, or Order of Beings, is, so much more numerous are the *Species* contain'd under it. As for Example: Birds being a more perfect Kind of Animals than Fishes, there are more of these than of those; and for the like Reason more Birds than Quadrupeds, and more Insects than of any of the Rest, and so more Plants than Animals, Nature being more sparing in her more excellent Productions. If this Rule, I say, holds good, then should there be more *Species* of *Fossils*, or generally of *inanimate Bodies*, than of *Vegetables*, of which there is some Reason to doubt, unless we will admit all Sorts of formed Stones to be distinct *Species*.

Animate Bodies are divided into four great *Genera*, or Orders, *Beasts*, *Birds*, *Fishes*, and *Insects*.

The *Species* of *Beasts*, including also *Serpents*, are not very numerous: Of such as are certainly known and describ'd, I dare not say above 150; and yet I believe, not many, that are of any considerable Bigness, in the known Regions of the World, have escap'd the Cognizance of the Curious. (I reckon all *Dogs* to be of one *Species*, they mingling together in Generation, and the Breed of such Mixtures being prolifick.)

The Number of *Birds* known and describ'd may be near 500; and the Number of *Fishes*, excluding *Shell-Fish*, as many: But if the *Shell-Fish* be taken in, more than six times the Number. How many of each *Genus* remain yet undiscover'd, one cannot certainly nor very near-

ly conjecture; but we may suppose the whole Sum of *Beasts* and *Birds* to exceed by a third Part, and *Fishes* by one half, those known.

The *Insects*, if we take in the *Exanguious* both *Terrestrial* and *Aquatick*, may, in Derogation to the precedent Rule, for Number, vie even with *Plants* themselves: For the *Exanguious* alone, by what that Learned and Critical Naturalist, my honour'd Friend, Dr. *Martin Lister*, hath already observ'd and delineated, I conjecture, cannot be fewer than 3000 *Species*, perhaps many more.

The *Butterflies* or *Beetles* are such numerous Tribes, that I believe in our own native Country alone the *Species* of each Kind may amount to 150 or more. And if we should make the *Caterpillers* and *Hexapods*, from whence these come, to be distinct *Species*, as most Naturalists have done, the Number will be doubled, and these two *Genera* will afford us 600 *Species*; But if those be admitted for distinct *Species*, I see no Reason but their *Aureliæ* also may pretend to a specifick Difference from the *Caterpillers* and *Butterflies*, and so we shall have 300 *Species* more; therefore we exclude both these from the Degree of *Species*, making them to be the same *Insect* under a different *Larva* or Habit.

The *Fly-kind*, if under that Name we comprehend all other flying *Insects*, as well such as have four, as such as have but two Wings, of both which Kinds there are many subordinate *Genera*, will be found in Multitude of *Species*

to

to equal, if not exceed, both the forementionʼd Kinds.

The *creeping Inſects* that never come to be wingʼd, thoʼ for Number they may fall ſhort of the flying or winged, yet are they alſo very numerous; as by running over the ſeveral Kinds I could eaſily demonſtrate. Suppoſing then there be a Thouſand ſeveral Sorts of Inſects in this Iſland and the Sea near it, if the ſame Proportion holds between the Inſects native in *England*, ann thoſe of the reſt of the World, as doth between Plants *domeſtick* and *exotick*, (that is, as I gueſs, near a Decuple) the Species of *Inſects* in the whole Earth (Land and Water) will amount to 10000, and I do believe they rather exceed than fall ſhort of that Sum. Since the Writing hereof, having this Summer, *Ann.* 1691, with ſome Diligence proſecuted the Hiſtory of our *Engliſh* Inſects, and making Collections of the ſeveral Species of each Tribe, but particularly and eſpecially of the *Butterflies*, both nocturnal and diurnal, I find the Number of ſuch of theſe alone as breed in our Neighbourhood (about *Braintree* and *Notely* in *Eſſex*) to exceed the Sum I laſt Year aſſignʼd to all *England*, having my ſelf obſervʼd and deſcribʼd about 200 Kinds great and ſmall, many yet remaining, as I have good Reaſon to believe, by me undiſcoverʼd. This I have, ſince the writing hereof, found true in Experience, having every Year obſervʼd not a few new Kinds: Nor do I think that, if I ſhould live 20 Years longer, I ſhould by my utmoſt Diligence and Induſtry in ſearch-

ing them out, come to an End of them. If then, within the ſmall Compaſs of a Mile or two, there are ſo many Species to be found, ſurely the moſt modeſt Conjecture cannot eſtimate the Number of all the Kinds of *Papilio*'s native of this Iſland to fall ſhort of 300, which is twice ſo many as I laſt Summer gueſs'd them to be; wherefore, uſing the ſame Argumentations, the Number of all the *Britiſh Inſects* will amount to 2000, and the total Sum of thoſe of the whole Earth will be 20000. The Number of Plants contain'd in *C. Bauhin*'s *Penax* is about 6000, which are all that had been deſcrib'd by the Authors that wrote before him, or obſerv'd by himſelf; in which Works, beſides Miſtakes and Repetitions incident to the moſt wary and knowing Men in ſuch a Work as that, there are a great many, I might ſay ſome Hundreds, put down for different Species, which in my opinion are but accidental Varieties: Which I do not ſay to detract from the excellent Pains and Performance of that Learned, Judicious and Laborious Herbariſt, or to defraud him of his deſerv'd Honour, but only to ſhew that he was too much ſway'd by the Opinions then generally current among Herbariſts, that different Colour or Multiplicity of Leaves in the Flower, and the like Accidents, were ſufficient to conſtitute a ſpecifick Difference. But ſuppoſing there had been 6000 then known and deſcrib'd, I cannot think but that there are in the World more than triple that Number; there being in the vaſt Continent of *America* as great a Variety

of

of *Species* as with us, and yet but few common to *Europe*, or perhaps *Africk* and *Asia*. And if, on the other Side the Equator, there be much Land ſtill remaining undiſcover'd, as probably there may, we muſt ſuppoſe the Number of Plants to be far greater.

What can we infer from all this? If the Number of Creatures be ſo exceeding great, how great, nay immenſe, muſt needs be the Power and Wiſdom of him who form'd them all! For (that I may borrow the Words of a noble and excellent Author) as it argues and manifeſts more Skill by far in an Artificer, to be able to frame both *Clocks* and *Watches*, and *Pumps*, and *Mills*, and *Granadoes*, and *Rockets*, than he could diſplay in making but one of thoſe ſorts of Engines; ſo the Almighty diſcovers more of his Wiſdom in forming ſuch a vaſt Multitude of different Sorts of Creatures, and all with admirable and irreproveable Art, than if he had created but a few; for this declares the Greatneſs and unbounded Capacity of his Underſtanding. Again, the ſame Superiority of Knowledge would be diſplay'd, by contriving Engines of the ſame Kind, or for the ſame Purpoſes, after different Faſhions, as the moving of Clocks or other Engines by Springs inſtead of Weights: So the infinitely wiſe Creator hath ſhewn in many Inſtances, that he is not confin'd to one only Inſtrument for the working one Effect, but can perform the ſame Thing by divers Means. So, tho' Feathers ſeem neceſſary for flying, yet hath he enabled ſeveral Creatures to fly without them,

them, as two Sorts of Fiſhes, one Sort of Lizard, and the Batt, not to mention the numerous Tribes of flying Inſects. In like Manner, tho' the Air-bladder in Fiſhes ſeems neceſſary for ſwimming, yet ſome are ſo form'd as to ſwim without it, *viz.* Firſt, the *Cartilagineous* Kind, which by what Artifice they poize themſelves, aſcend and deſcend at Pleaſure, and continue in what Depth of Water they liſt, is as yet unknown to us. Secondly the *Cetaceous* Kind, or Sea-beaſts, differing in nothing almoſt from Quadrupeds but the Want of Feet. The Air which in Reſpiration theſe receive into their Lungs, may ſerve to render their Bodies equiponderant to the Water; and the Conſtrictiion or Dilatation of it, by the Help of the Diaphragm and Muſcles of Reſpiration, may probably aſſiſt them to aſcend or deſcend in the Water, by a light Impulſe thereof with their Fins.

Again, Tho' the Water being a cold Element, the moſt wiſe GOD hath ſo attemper'd the Blood and Bodies of Fiſhes in general, that a ſmall Degree of Heat is ſufficient to preſerve their due Conſiſtency and Motion, and to maintain Life; yet to ſhew that he can preſerve a Creature in the Sea, and in the coldeſt Part of the Sea too, that may have as great a Degree of Heat as Quadrupeds themſelves, he hath created Variety of theſe cetaceous Fiſhes, which converſe chiefly in the Northern Seas, whoſe whole Body being incompaſs'd round with a copious Fat or Blubber (which, by reflecting and redoubling the internal Heat, and keeping off the exter-

nal

nal Cold, doth the ſame thing to them that Cloaths do to us) is enabled to abide the greateſt Cold of the Sea-water. The Reaſon why theſe *Fiſhes* delight to frequent chiefly the *Northern* Seas, is, I conceive, not only for the Quiet which they enjoy there, but becauſe the *Northern* Air, which they breathe in, being more fully charg'd with thoſe Particles ſuppos'd nitrous, which are the Element of Fire, is fitteſt to maintain the vital Heat in that Activity which is ſufficient to move ſuch an unweildy Bulk as their Bodies are with due Celerity, and to bear up againſt and repel the ambient Cold; and may likewiſe enable them to continue longer under Water than a warmer and thinner Air could.

Another Inſtance to prove that God can and doth by different Means produce the ſame Effect, is the various Ways of extracting the nutritious Juice out of the Aliment, in ſeveral Kinds of Creatures.

1. In *Man* and *viviparous Quadrupeds* the Food moiſten'd with the Spittle *(ſaliva)* is firſt chew'd and prepared in the Mouth, then ſwallowed into the Stomach, where being mingled with ſome diſſolvent Juices, it is by the Heat hereof concocted, macerated, and reduc'd into a Chyle or Cremor, and ſo evacuated into the Inteſtines, where being mixed with the Choler and *Pancreatick* Juice, it is further ſubtiliz'd and render'd ſo fluid and penetrant, that the thinner and finer Part of it eaſily finds its Way in at the ſtreight Orifices of the lacteous Veins.

2. In-

2. In *Birds* there is no Maſtication or Comminution of Meat in the Mouth; but in ſuch as are not Carniverous, it is immediately ſwallow'd into the Crop or Craw, or at leaſt into a Kind of Anteſtomach (which I have obſerv'd in many, eſpecially in *Piſcivorous Birds*) where it is moiſtned and mollified by ſome proper Juice from the Glandules diſtilling in there, and thence transfer'd into the Gizard or Muſculous Stomach, where by the working of the Muſcles compounding the Side of that Ventricle, and by the Aſſiſtance of ſmall Pebbles (which the Creature ſwallows for that Purpoſe) it is, as it were by Mill-ſtones, ground ſmall, and ſo tranſmitted to the Guts, to be further attenuated and ſubtiliz'd by the fore-mentioned Choler and Pancreatick Juice.

3. In *oviparous Quadrupeds*, as *Chamelions*, *Lizards*, *Frogs*, as alſo in all Sorts of *Serpents*, there is no Maſtication or Comminution of the Meat either in Mouth or Stomach; but as they ſwallow *Inſects* or other Animals whole, ſo they avoid their Skins unbroken, having a Heat, or Spirits, powerful enough to extract the Juice they have Need of, without breaking that which contains it; as the *Pariſian Academiſts* tell us. I myſelf cannot warrant the Truth of the Obſervation in all. Here, by the by, we take Notice of the wonderful Dilatability or Extenſiveneſs of the Throats and Gullets of *Serpents:* I myſelf have taken two entire adult *Mice* out of the Stomach of an *Adder*. whoſe Neck was not bigger than my little Finger. Theſe Creatures, I ſay, draw out the Juice of what they ſwallow with-

without any Comminution, or so much as breaking the Skin; even as it is seen that the Juice of Grapes is drawn as well from the * Rape, where they remain whole, as from a Vat, where they are bruis'd; to borrow the *Parisian* Philosophers Similitude.

* Whole Grapes pluck'd from the Cluster, and Wine pour'd upon them in a Vessel.

4. *Fishes*, which neither chew their Meat in their Mouths, nor grind it in their Stomachs, do by the Help of a dissolvent Liquor, there by Nature provided, corrode, and reduce it, Skin, Bones and all, into a *Chylus* or *Cremor*; and yet (which may seem wonderful) this Liquor manifests nothing of Acidity to the Taste: But notwithstanding, how mild and gentle soever it seems to be, it corrodes Flesh very strangely and gradually, as *Aquafortis*, or the like corrosive Waters, do Metals, as appears to the Eye; for I have observed Fish in the Stomachs of others thus partially corroded, first the superficial Part of the Flesh, and then deeper and deeper by Degrees to the Bones.

I come now to the second Part of the Words, *In Wisdom hast thou made them all*; in discoursing whereof I shall endeavour to make out in Particulars what the *Psalmist* here asserts in general concerning the Works of God, that they are all very wisely contrived and adapted to Ends both particular and general.

But before I enter upon this Task, I shall, by Way of *Preface*, or *Introduction*, say something concerning those Systems which undertake to give

give an Account of the Formation of the Universe by Mechanical *Hypotheses* of Matter, mov'd either uncertainly, or according to some Catholick Laws, without the Intervention and Assistance of any superior immaterial Agent.

There is no greater, at least no more palpable and convincing Argument of the Existence of a Deity, than the admirable Art and Wisdom that discovers itself in the Make and Constitution, the Order and Disposition, the Ends and Uses of all the Parts and Members of this stately Fabrick of Heaven and Earth: For if in the Works of Art (as for Example) a curious Edifice, or Machine, Council, Design, and Direction, to an End appearing in the whole Frame, and in all the several Pieces of it, do necessarily infer the Being and Operation of some intelligent Architect, or Engineer; why should not also, in the Works of Nature, that Grandeur and Magnificence, that excellent Contrivance for Beauty, Order, Use, *&c.* which is observable in them, wherein they do as much transcend the Effects of human Art, as infinite Power and Wisdom exceeds finite, infer the Existence and Efficiency of an Omnipotent and All-wise Creator?.

To evade the Force of this Argument, and to give some Account of the Original of the World, Atheistical Persons have set up two *Hypotheses.*

The first is that of *Aristotle*, that the World was from Eternity in the same Condition that now it is, having run through the Successions of infinite Generations; to which they add, Self-ex-

exiſtent and Unproduc'd: For *Ariſtotle* doth not deny God to be the *efficient Cauſe* of the World; but only aſſerts, that he created it from Eternity, making him a neceſſary Cauſe thereof; it proceeding from him by Way of Emanation, as Light from the Sun.

This *Hypotheſis*, which hath ſome Shew of Reaſon, for ſomething muſt neceſſarily exiſt of itſel; and if ſomething why may not all Things? This *Hypotheſis*, I ſay, is ſo clearly and fully confuted by the Reverend and Learned Dr. *Tillotſon*, late Lord Archbiſhop of *Canterbury*, and Primate of all *England*, in his firſt printed Sermon; and the Right Reverend Father in God, *John*, late Lord Biſhop of *Cheſter*, in Book I. Chap. V. of his Treatiſe of the *Principles of Natural Religion*, that nothing material can by me be added: To whom therefore I refer the Reader.

The Epicurean *Hypotheſis rejected.*

The ſecond *Hypotheſis* is that of the *Epicureans*, who held, that there were two Principles ſelf-exiſtent. Firſt, *Space*, or *Vacuity*; Secondly, *Matter*, or *Body*; both of infinite Duration and Extenſion. In this infinite Space, or Vacuity, which hath neither Beginning, nor End, nor Middle, no Limits, or Extreams, innumerable minute Bodies, into which the Matter was divided, call'd *Atoms*, becauſe by Reaſon of their perfect Solidity they were really indiviſible (for they hold no Body capable of Diviſion,

vision, but what hath Vacuities interspers'd with Matter, of various but a determinate Number of Figures, and equally ponderous, do perpendicularly descend, and by their fortuitous Concourse make compound Bodies, and at last the World itself. But now, because if all these Atoms should descend plum down with equal Velocity, as according to their Doctrine they ought to do, being (as we said) all perfectly solid and imporous, and the *Vacuum* not resisting their Motion, they would never the one overtake the other, but like the Drops of a Shower would always keep the same Distances, and so there could be no Concourse, or Cohæsion of them, and consequently nothing created; partly to avoid this destructive Consequence, and partly to give some Account of the Freedom of Will (which they did assert contrary to the *Democratick* Fate) they did absurdly feign a Declination of some of these Principles, without any Shadow, or Pretence of Reason. The former of these Motives you have set down by *Lucretius de Nat. Rerum*, L. 2. in these Words:

Corpora cum deorsum rectum per inane feruntur
Ponderibus propriis, incerto Tempore fortè,
Incertisque locis, Spatio discedere paulùm;
Tantum quod nomen mutatum dicere possis.

And again,

Quod nisi declinare solerent, omnia deorsum
Imbris uti guttæ caderent per inane profundum,
Nec foret offensus natus, nec plaga creata
Principiis, ita nil unquam natura creâsset.

Now

Now Seeds in downward Motion muſt decline,
Tho' vary little from th' exacteſt Line;
For did they ſtill move ſtrait, they needs muſt fall
Like Drops of Rain, diſſolv'd and ſcatter'd all,
For ever tumbling thro' the mighty Space,
And never join to make one ſingle Maſs.

The ſecond Motive they had to introduce this gratuitous Declination of Atoms, the ſame Poet gives us in theſe Verſes, *Lib.* 2.

——Si ſemper motus connectitur omnis,
Et vetere exoritur ſemper novus ordine certo;
Nec declinando faciunt primordia motûs
Principium quoddam quod fati fœdera rumpat,
Ex infinito nè cauſam cauſa ſequatur;
Libra per terras unde hæc animantibus, extat,
Unde hæc eſt, inquam, fatis avolſa voluntas?

Beſides, did all Things move in direct Line,
And ſtill one Motion to another join
In certain Order, and no Seeds decline,
And make a Motion fit to diſſipate
The well-wrought Chains of Cauſes and ſtrong Fate;
Whence comes that Freedom living Creatures find?
Whence comes the Will ſo free, ſo unconfin'd,
Above the Power of Fate?

The Folly and Unreaſonableneſs of this ridiculous and ungrounded Figment, I cannot better

ter display and reprove than in the Words of *Cicero*, in the Beginning of his first Book *De Finibus Bonorum & Malorum.* This Declination (saith he) is altogether childishly feign'd, and yet neither doth it at all solve the Difficulty, or effect what they desire: For, first, They say the Atoms decline, and yet assign no Reason why. Now nothing is more shameful and unworthy a Natural Philosopher [*turpius Physico*] than to assert any thing to be done without a Cause, or to give no Reason of it. Besides, this is contrary to their own *Hypothesis* taken from Sense, that all Weights do naturally move perpendicularly downwards. Secondly, Again supposing this were true, and that there were such a Declination of Atoms, yet will it not effect what they intend; for either they do all decline, and so there will be no more Concourse than if they did perpendicularly descend; or some decline, and some fall plum down, which is ridiculously to assign distinct Offices and Tasks to the Atoms, which are all of the same Nature and Solidity. Again, in his Book *De Fato*, he smartly derides this fond Conceit thus; What Cause is there in Nature which turns the Atoms aside? Or do they cast Lots among themselves which shall decline, which not? Or why do they decline the least Interval that may be, and not a greater? why not two or three *minima* as well as one? *Optare hoc quidem est non disputare.* For neither is the Atom by any extrinsical Impulse diverted from its natural Course; neither can there be any Cause imagin'd in the Vacuity through

which it is carried, why it ſhould not move directly; neither is there any Change made in the Atom it ſelf, that it ſhould not retain the Motion natural to it, by Force of its Weight or Gravity.

As for the whole *Atomical Hypotheſis*, either *Epicurean* or *Democritick*, I ſhall not, nor need I, ſpend Time to confute it; this having been already ſolidly and ſufficiently done by many learned Men, but eſpecially Dr. *Cudworth*, in his *Intellectual Syſtem of the Univerſe*, and the late Biſhop of *Worceſter*, Dr. *Stillingfleet*, in his *Origines Sacræ*. Only I cannot omit the *Ciceronian* Confutation thereof, which I find in the Place firſt quoted, and in the firſt and ſecond Books *De Naturâ Deorum*, becauſe it may ſerve as a general Introduction to the following Particulars. Such a turbulent Concourſe of Atoms could never, (ſaith he) *hunc mundi ornatum efficere*, compoſe ſo well-order'd and beautiful a Structure as the *World*; which therefore both in *Greek* and *Latin* hath from thence [*ab ornatu & munditie*] obtain'd its Name. And again moſt fully and appoſitely in his ſecond *De Nat. Deorum:* If the Works of *Nature* are better, more exact and perfect, than the Works of *Art*, and *Art* effects nothing without Reaſon, neither can the Works of *Nature* be thought to be effected without Reaſon; for, is it not abſurd and incongruous, that when thou beholdeſt a Statue or curious Picture, thou ſhould'ſt acknowledge that Art was us'd to the making of it; or when thou ſeeſt the Courſe of a Ship upon the Waters, thou

ſhouldſt not doubt but the Motion of it is regulated and directed by Reaſon and Art; or when thou conſidereſt a Sun-dyal or Clock, thou ſhouldſt underſtand preſently, that the Hours are ſhewn by Art, and not by Chance; and yet imagine or believe, that the World, which comprehends all theſe Arts and Artificers, was made without Counſel or Reaſon? If one ſhould carry into *Scythia* or *Britain* ſuch a Sphere as our Friend *Poſſidonius* lately made, each of whoſe Converſions did the ſame Thing in the *Sun*, and *Moon*, and other five *Planets*, which we ſee effected every Night and Day in the Heavens, who among thoſe Barbarians would doubt that that Sphere was compos'd by Reaſon and Art? A Wonder then it muſt needs be, that there ſhould be any Man found ſo ſtupid and forſaken of Reaſon, as to perſuade himſelf, that this moſt beautiful and adorn'd World, was, or could, be produced by the fortuitous Concourſe of Atoms. He that can prevail with himſelf to believe this, I do not ſee why he may not as well admit, that if there were made innumerable Figures of the one and twenty Letters, in Gold, ſuppoſe, or any other Metal, and theſe well ſhaken and mixt together, and thrown down from ſome high Place to the Ground, they, when they lighted upon the Earth, would be ſo diſpos'd and rank'd that a Man might ſee and read in them *Ennius*'s *Annals*; whereas it were a great Chance if he ſhould find one Verſe thereof among them all: For if this Concourſe of Atoms could make a whole World, why may it not ſometimes make,

and why hath it not somewhere or other in the Earth made, a Temple, or a Gallery, or a *Portico*, or a House, or a City? which yet it is so far from doing, and every Man so far from believing, that should any one of us be cast, suppose, upon a desolate *Island*, and find there a magnificent Palace, artificially contriv'd according to the exactest Rules of Architecture, and curiously adorn'd and furnish'd, it would never once enter into his Head, that this was done by an Earthquake, or the fortuitous shuffling together of its component Materials; or that it had stood there ever since the Construction of the *World*, or first Cohæsion of *Atoms*; but would presently conclude, that there had been some intelligent Architect there, the Effect of whose Art and Skill it was. Or should he find there but one single Sheet of Parchment or Paper, an Epistle or Oration written, full of profound Sense, express'd in proper and significant Words, illustrated and adorn'd with elegant Phrase; it were beyond the Possibility of the Wit of Man to persuade him that this was done by the temerarious Dashes of an unguided Pen, or by the rude Scattering of Ink upon the Paper, or by the lucky Projection of so many Letters at all Adventures; but he would be convinced by the Evidence of the Thing at first Sight, that there had been not only some Man, but some Scholar there.

The Cartesian Hypothesis *consider'd and censur'd.*

Having rejected this *Atheistick Hypothesis* of

Epicurus and *Democritus*, I ſhould now proceed to give particular Inſtances of the Art and Wiſdom clearly appearing in the ſeveral Parts and Members of the Univerſe; from which we may juſtly infer this general Concluſion of the Pſalmiſt, *In Wiſdom haſt thou made them all:* But that there is a Sort of profeſſed *Theiſts*, I mean Monſ. *Des Cartes*, and his Followers, who endeavour to diſarm us of his decretory Weapon to evacuate and exterminate this Argument, which hath been ſo ſucceſsful in all Ages to demonſtrate the Exiſtence, and enforce the Belief of a Deity, and to convince and ſilence all Atheiſtick Gainſayers. And this they do,

Firſt, By excluding and baniſhing all Conſideration of final Cauſes from Natural Philoſophy, upon Pretence, that they are all and every one in particular undiſcoverable by us; and that it is Raſhneſs and Arrogance in us to think we can find out God's End, and be Partakers of his Councils. *Atque ob hanc unicam rationem, totum illud cauſarum genus quod à fine peti ſolet, in rebus Phyſicis nullum uſum habere exiſtimo; non enim abſque temeritate me puto inveſtigare poſſe fines Dei.* Medit. Metaph. *And for this only Reaſon, I think, all that Kind of Cauſes which is wont to be taken from the End, to have no Uſe in Phyſics or natural Matters; for I cannot without Raſhneſs think my ſelf able to find out the Ends of God.* And again, in his *Principles of Philoſophy*; *Nullas unquam rationes circa res Naturales, à fine quem Deus aut Natura in iis faciendis ſibi propoſuit, admittimus, quia non tantum nobis de-*

bemus

bemus arrogare ut ejus Conciliorum participes esse possimus. We can by no Means admit any Reasons about natural Things, taken from the End which God or Nature propos'd to themselves in making of them; because we ought not to arrogate so much to our selves, as to think we may be Partakers of his Counsels. And more expresly in his fourth Answer, *viz.* to *Gassendus*'s Objections; *Nec fingi potest, aliquos Dei fines magis quam alios in propatulo esse; omnes enim imperscrutabili ejus Sapientiæ abysso sunt eodem modo reconditi*; That is, *Neither can nor ought we to feign or imagine that some of God's Ends are more manifest than others; for all lie in like Manner, or equally hidden, in the unsearchable Abyss of his* Wisdom.

This confident Assertion of *Des Cartes* is fully examin'd and reprov'd by that honourable and excellent Person, Mr. *Boyle*, in his *Disquisition about the final Causes of natural Things*, Sect. 1. from page 10. to the End; and therefore I shall not need say much to it, only in brief this, that it seems to me false, and of evil Consequence, as being derogatory from the Glory of God, and destructive of the Acknowledgment and Belief of a Deity.

For first, Seeing (for Instance) that the Eye is employ'd by Man and all Animals for the Use of Vision, which, as they are fram'd, is so necessary for them, that they could not live without it; and God Almighty knew that it would be so; and seeing it is so admirably fitted and adapted to this Use, that all the *Wit* and

Art of Men and Angels could not have contriv'd it better, if so well; it must needs be highly absurd and unreasonable to affirm, either that it was not design'd at all for this Use, or that it is impossible for Man to know whether it was or not.

Secondly, How can Man give Thanks and Praise to God for the Use of his Limbs and Senses, and those his good Creatures which serve for his Sustenance, when he cannot be sure they were made in any Respect for him; nay, when 'tis as likely they were not, and that he doth but abuse them to serve Ends for which they were never intended?

Thirdly, This Opinion, as I hinted before, supersedes and cassates the best *Medium* we have to demonstrate the Being of a Deity, leaving us no other demonstrative Proof but that taken from the innate *Idea*; which, if it be a Demonstration, is but an obscure one, not satisfying many of the Learned themselves, and being too subtle and metaphysical to be apprehended by vulgar Capacities, and consequently of no Force to persuade and convince them.

Secondly, They endeavour to evacuate and disannul our great Argument, by pretending to solve all the *Phænomena* of Nature, and to give an Account of the Production and Efformation of the Universe, and all the corporeal Beings therein, both celestial and terrestrial, as well animate as inanimate, not excluding Animals themselves, by a slight *Hypothesis* of Matter so and so divided and moved. The *Hypothesis* you have

have in *Des Cartes*'s *Principles of Philoſophy*, Part 2. *All the Matter of this viſible World is* by him ſuppos'd *to have been at firſt divided by God into Parts nearly equal to each other, of a mean Size*, viz. *about the Bigneſs of thoſe whereof the Heavenly Bodies are now compounded; all together having as much Motion as is now found in the World; and theſe to have been equally mov'd ſeverally every one by it ſelf about its own Center, and among one another, ſo as to compoſe a fluid Body; and alſo many of them jointly, as in company, about ſeveral other Points ſo far diſtant from one another, and in the ſame Manner diſpos'd as the Centers of the fix'd Stars now are.* So that God had no more to do than to create the Matter, divide it into Parts, and put it into Motion, according to ſome few Laws, and that would of it ſelf produce the World, and all Creatures therein.

For a Confutation of this *Hypotheſis*, I might refer the Reader to Dr. *Cudworth*'s Syſtem *p.* 603, 604. but for his Eaſe I will tranſcribe the Words: —— God, in the mean Time, ſtanding by as an idle Spectator of this *Lucus Atomorum*, this ſportful Dance of *Atoms*, and of the various Reſults thereof. Nay, theſe *mechanick Theiſts* have here quite outſtripp'd and outdone the *Atomick Theiſts* themſelves, they being much more extravagant than ever thoſe were; for the profeſſed *Atheiſts* durſt never venture to affirm, that this regular *Syſtem* of Things reſulted from the *fortuitous Motions* of Atoms at the very firſt, before they had for a long Time together produced many other *inept Combinations*, or *aggregate Forms*

Forms of particular Things, and *nonſenſical Syſtems* of the Whole; and they ſuppos'd alſo, that the *Regularity* of Things here in this World would not always continue ſuch neither, but that ſome Time or other, Confuſion and Diſorder will break in again. Moreover, that beſides this World of ours, there are at this very Inſtant innumerable other Worlds *irregular*, and that there is but one of a thouſand, or Ten Thouſand among the infinite Worlds that have ſuch Regularity in them; the Reaſon of all which is, becauſe it was generally taken for granted, and look'd upon as a common Notion, that τῶν ἀπὸ τύχης καὶ τοῦ αὐτομάτου οὐδὲν ἀεὶ οὕτω γίνεται, as *Ariſtotle* expreſſeth it; none of thoſe Things which are from Fortune, or Chance, come to paſs always alike. But our *mechanick Theiſts* will have their Atoms never ſo much as once to have fumbled in theſe their Motions, nor to have produc'd any inept Syſtem, or incongruous Forms at all, but from the very firſt all along to have taken up their Places, and ranged themſelves ſo orderly, methodically and directly, as that they could not poſſibly have done it better had they been directed by the moſt perfect Wiſdom. Wherefore theſe *Atomick Theiſts* utterly evacuate that grand Argument for a God taken from the *Phænomenon* of the Artificial Frame of Things, which hath been ſo much inſiſted upon in all Ages, and which commonly makes the ſtrongeſt Impreſſion of any other upon the Minds of Men, *&c.* the *Atheiſts*, in the mean Time, laughing in their *Sleeves*, and not a little triumphing to ſee the Cauſe

Cauſe of *Theiſm* thus betray'd by its profeſs'd Friends and Aſſerters, and the grand Argument for the ſame totally ſlurr'd by them, and ſo their Work done, as it were, to their Hands.

Now as this argues the greateſt Inſenſibility of Mind, or Sottiſhneſs and Stupidity in pretended *Theiſts*, not to take the leaſt Notice of the regular and artificial Frame of Things, or of the Signatures of the Divine Art and Wiſdom in them, nor to look upon the *World* and *Things of Nature* with any other Eyes than Oxen and Horſes do; ſo are there many *Phænomena's* in Nature, which being partly above the Force of theſe *mechanick Powers*, and partly contrary to the ſame, can therefore never be ſolv'd by them, nor without *final Cauſes*, and ſome *vital Principles:* As for Example, that of Gravity, or the Tendency of Bodies downward, the Motion of the *Diaphragm* in Reſpiration, the *Syſtole* and *Diaſtole* of the Heart, which is nothing but a Muſcular Conſtriction and Relaxation, and therefore not *mechanical* but *vital.* We might alſo add, among many others, the Interſection of the Planes of the *Equator* and *Ecliptick*, or the Earth's diurnal Motion upon an *Axis* not parallel to that of the *Ecliptick*, nor perpendicular to the Plane thereof: For tho' *Des Cartes* would need imagine this Earth of ours once to have been a Sun, and ſo it ſelf the Centre of a leſſer *Vortex*, whoſe *Axis* was then directed after this Manner, and which therefore ſtill kept the ſame Site or Poſture, by Reaſon of the ſtrait Particles finding no fit Pores, or Traces, for their Paſſages through it,

it, but only in this Direction; yet does he himself confess, that because these two Motions of the Earth, the Annual and Diurnal, would be much more conveniently made upon parallel *Axes*, therefore, according to the Laws of Mechanism, they should be perpetually brought nearer and nearer together, till at length the *Equator* and *Ecliptick* come to have their *Axes* parallel, which, as it hath not yet come to pass, so neither hath there been for these last Two Thousand Years (according to the best Observations and Judgments of Astronomers) any nearer Approach made of them one to another. Wherefore the Continuation of these two Motions of the Earth, the Annual and Diurnal, upon *Axes* not parallel, is resolvable into nothing but a *final* and *mental* Cause, or the τὸ Βέλτιςον, because it was best it should be so, the Variety of the Seasons of the Year depending thereupon. But the greatest of all the particular *Phænomena*, is the Formation and Organization of the Bodies of Animals, consisting of such Variety and Curiosity, that these mechanick Philosophers being no way able to give an Account thereof from the necessary Motion of Matter, *unguided by Mind for Ends*, prudently therefore break off their System there, when they should come to Animals, and so leave it altogether untouch'd. We acknowledge indeed there is a *Posthumous* Piece extant, imputed to *Cartes*, and entitled, *De la Formation du Fœtus*, wherein there is some Pretence made to solve all this fortuitous Mechanism. But as the Theory thereof is built wholly upon a false Supposition,

ſition, ſufficiently confuted by our *Harvey*, in his Book of *Generation*, *That the Seed doth materially enter into the Compoſition of the Egg*; ſo is it all along precarious and exceptionable: Nor doth it extend at all to Differences that are in ſeveral *Animals*, nor offer the leaſt Reaſon why an *Animal* of one *Species* might not be form'd out of the Seed of another. Thus far the *Doctor*, with whom for the main I do conſent. I ſhall only add, that Natural Philoſophers, when they endeavour to give an Account of any of the Works of Nature, by preconceiv'd Principles of their own, are for the moſt Part groſly miſtaken, and confuted by Experience; as *Des Cartes* in a Matter that lay before him, obvious to Senſe, and infinitely more eaſy to find out the Cauſe of, than to give an Account of the Formation of the World; that is, the Pulſe of the Heart, which he attributes to an Ebullition and ſudden Expanſion of the Blood, in its Ventricles, after the Manner of the Milk, which being heated to ſuch a Degree, doth ſuddenly, and as it were all at once, fluſh up and run over the Veſſel. Whether this Ebullition be caus'd by a Nitro-Sulphureous Ferment lodg'd eſpecially in the left Ventricle of the Heart, which mingling with the Blood, excites ſuch an Ebullition, as we ſee made by the Mixture of ſome chymical Liquors, *viz.* Oil of Vitriol, and deliquated Salt of Tartar; or, by the vital Flame warming and boiling the Blood. But this Conceit of his is contrary both to Reaſon and Experience: For, firſt, it is altogether

unrea-

unreasonable to imagine and affirm that the cool venal Blood should be heated to so high a Degree in so short a Time as the Interval of two Pulses, which is less than the sixth Part of a Minute. Secondly, in cold Animals, as for Example, *Eels*, the Heart will beat for many Hours after it is taken out of the Body, yea, tho' the Ventricle be open'd, and all the Blood squeez'd out. Thirdly, The Process of the Fibres which compound the Sides of the Ventricles running in Spiral Lines from the Tip to the Base of the Heart, some one Way, and some the contrary, do clearly shew that the *Systole* of the Heart is nothing but a Muscular Constriction, as a Purse is shut by drawing the Strings contrary-ways; which is also confirmed by Experience: For if the *Vertex* of the Heart be cut off, and a Finger thrust up into one of the Ventricles, in every *Systole* the Finger will be sensibly and manifestly pinch'd by the Sides of the Ventricle. But for a full Confutation of this Fancy, I refer the Reader to Dr. *Lower*'s Treatise *De Corde*, *cap.* 2. and *Des Cartes*'s Rules concerning the transferring of Motion from one Body in Motion to another in Motion, or in Rest, are the most of them by Experience found to be false; as they affirm who have made Trial of them.

The Pulse of the Heart Dr. *Cudworth* would have to be no Mechanical, but a Vital Motion, which to me seems probable, because it is not under the Command of the Will; nor are we conscious of any power to cause, or to restrain it, but it is carried on and continued without our Know-

Knowledge, or Notice; neither can it be cauſed by the Impulſe of any external Movent, unleſs it be Heat. But how can the Spirit, agitated by Heat, unguided by a *vital Principle*, produce ſuch a regular reciprocal Motion? If that Site which the Heart and its Fibres have in the *Diaſtole* be moſt natural to them, (as it ſeems to be) why doth it again contract it ſelf, and not reſt in that Poſture? If it be once contracted in a *Syſtole* by the Influx of the Spirits, why, the Spirits continually flowing in without Let, doth it not always remain ſo? [for the *Syſtole* ſeems to reſemble the forcible Bending of a Spring, and the *Diaſtole* its flying out again to its natural Site.] What is the Spring and principal Efficient of this Reciprocation? What directs and moderates the Motions of the Spirits? They being but ſtupid and ſenſeleſs Matter, cannot of themſelves continue any regular and conſtant Motion, without the Guidance and Regulation of ſome intelligent Being. You will ſay, What Agent is it which you would have to effect this? The ſenſitive Soul it cannot be, becauſe that is indiviſible; but the Heart when ſeparated wholly from the Body in ſome *Animals*, continues ſtill to pulſe for a conſiderable Time: Nay, when it hath quite ceas'd, it may be brought to beat a-new by the Application of warm Spittle, or by pricking it gently with a Pin, or Needle. I anſwer, it may be in theſe Inſtances, the ſcattering Spirits remaining in the Heart, may for a Time, being agitated by the Heat, cauſe theſe faint Pulſations; tho' I ſhould rather attribute them to a *plaſtick Nature*,

Nature, or vital Principle, as the Vegetation of Plants must also be.

But, to proceed, neither can I wholly acquiesce in the *Hypothesis* of that *Honourable and deservedly Famous Author*, I formerly had Occasion to mention, which I find in his *free Enquiry into the vulgar Notion of Nature*, p. 77, 78. deliver'd in these Words. " I think it probable, " that the great and wise Author of Things did, " when he first form'd the Universe and undistinguish'd Matter into the World, put its Parts " into various Motions, whereby they were ne- " cessarily divided into numberless Portions of " differing Bulks, Figures, and Situations, in Re- " spect of each other: And that by his infinite " Wisdom and Power, he did so guide and over- " rule the Motions of these Parts, at the Begin- " ning of Things, as that (whether in a shorter " or a longer Time, Reason cannot determine) " they were finally dispos'd into that beautiful " and orderly Frame that we call the *World*; " among whose Parts some were so curiously " contriv'd, as to be fit to become the Seed, or " seminal Principles, of Plants and Animals. " And, I further conceive, that he settled such " Laws, or Rules, of local Motion among the " Parts of the Universal Matter, that by his or- " dinary and preserving Concourse, the several " Parts of the Universe thus once compleated, " should be able to maintain the great Con- " struction, or System, and Oeconomy of the " Mundane Bodies, and propagate the Species " of living Creatures." The same *Hypothesis* he repeats

repeats again, pag. 124, 125. of the ſame Treatiſe.

This *Hypotheſis*, I ſay, I cannot fully acquieſce in, becauſe an intelligent Being ſeems to me requiſite to execute the Laws of Motion: For firſt, Motion being a fluent Thing, and one Part of its Duration being abſolutely independent upon another, it doth not follow, that becauſe any thing moves this Moment, it muſt neceſſarily continue to do ſo the next, unleſs it were actually poſſeſs'd of its future Motion, which is a Contradiction; but it ſtands in as much Need of an Efficient to preſerve and continue its Motion, as it did at firſt to produce it. Secondly, Let Matter be divided into the ſubtileſt Parts imaginable, and theſe be mov'd as ſwiftly as you will, it is but a ſenſeleſs and ſtupid Being ſtill, and makes no nearer approach to Senſe, Perception, or vital Energy, than it had before; and do but only ſtop the internal Motion of its Parts, and reduce them to Reſt, the fineſt and moſt ſubtile Body that is, may become as groſs, and heavy, and ſtiff, as Steel, or Stone. And, as for any external Laws, or eſtabliſh'd Rules of Motion, the ſtupid Matter is not capable of obſerving, or taking any Notice of them, but would be as ſullen as the Mountain was that *Mahomet* commanded to come down to him; neither can thoſe Laws execute themſelves: Therefore there muſt, beſides Matter and Law, be ſome Efficient, and that either a Quality, or Power, inherent in the Matter it ſelf, which is hard to conceive, or ſome

external intelligent Agent, either God himself immediately, or some *Plastick Nature*.

Happening lately to read *The Christian Virtuoso*, written by the same Author of the *Enquiry into the vulgar Notions of Nature*, (the illustrious Mr. *Boyle*) I find therein these Words: " Nor will the Force of all that has been said " for God's special Providence be eluded, by " saying, with some Deists, That after the first " Formation of the Universe, all Things were " brought to pass by the settled Laws of Nature. " For though this be confidently, and not with- " out Colour, pretended, yet, I confess, it doth " not satisfie me:——For I look upon a Law as " a Moral, not Physical Cause, as being indeed " but a notional Thing, according to which an " intelligent and free Agent is bound to regulate " its Actions. But inanimate Bodies are utterly " uncapable of understanding what it is, or what " it enjoins, or when they act conformably, or " unconformably to it: Therefore the Actions " of inanimate Bodies, which cannot incite, or " moderate their own Actions, are produced by " real Power, not by Laws.

All this being consonant to what I have here written, against what I took to be this Honourable Person's *Hypothesis*, I must needs, to do him Right, acknowledge my self mistaken; perceiving now, that his Opinion was, that God Almighty did not only establish Laws and Rules of local Motion among the Parts of the universal Matter, but did, and does also himself, execute them, or move the Parts of Matter, according

to

to them: So that we are in the main agreed, differing chiefly about the Agent that executes those Laws, which he holds to be God himself immediately, we a Plastick Nature; for the Reasons alledg'd by Dr. *Cudworth*, in his System, *pag.* 149. which are, First, Because the former, according to vulgar Apprehension, would render the Divine Providence operose, solicitous, and distractious; and thereby make the Belief of it entertain'd with greater Difficulty, and give Advantage to Atheists. Secondly, It is not so decorous in Respect of God, that he should αὐτουργῆν ἅπαντα, set his own Hand, as it were, to every Work, and immediately do all the meanest and trifling'st Things himself drudgingly, without making Use of any inferior or subordinate Minister. These two Reasons are plausible, but not cogent; the two following are of greater Force. Thirdly, The slow and gradual Process that is in the Generation of Things, which would seem to be a vain and idle Pomp, or trifling Formality, if the Agent were omnipotent. Fourthly, Those ἁμαρτήματα, as *Aristotle* calls them, those Errors and Bungles which were committed when the Matter is inept, or contumacious, as in Monsters, *&c.* which argue the Agent not to be irresistible; and that Nature is such a Thing as is not altogether uncapable, as well as human Art, of being sometimes frustrated and disappointed by the Indisposition of the Matter: Whereas an omnipotent Agent would always do its Work infallibly and irresistibly, no Ineptitude, or Stubbornes of the Matter being ever

able to hinder such an one, or make him bungle, or fumble in any thing. So far the Doctor. For my Part, I should make no Scruple to attribute the Formation of *Plants*, their Growth and Nutrition, to the vegetable Soul in them; and likewise the Formation of *Animals*, to the Vegetative Power of their Souls; but that the Segments and Cuttings of some Plants, nay, the very Chips and smallest Fragments of their Body, Branches, or Roots, will grow and become perfect Plants themselves, and so the vegetable Soul, if that were the Architect, would be divisible, and consequently no spiritual, or intelligent Being; which the *Plastick Principle* must be, as we have shewn: For that must preside over the whole Oeconomy of the Plant, and be one single Agent, which takes Care of the Bulk and Figure of the Whole, and the Situation, Figure, Texture of all the Parts, Root, Stalk, Branches, Leaves, Flowers, Fruit, and all their Vessels and Juices. I therefore incline to Dr. *Cudworth*'s Opinion, that God uses for these Effects the subordinate Ministry of some inferior *Plastick Nature*; as, in his Works of Providence, he doth of Angels. For the Description whereof I refer the Reader to his *System*.

Secondly, In particular I am difficult to believe, that the *Bodies* of *Animals* can be form'd by Matter divided and mov'd by what Laws you will, or can imagine, without the immediate Presidency, Direction, and Regulation of some intelligent Being. In the Generation, or first Formation of, suppose, the human Body out of

(tho' not an homogeneous Liquor, yet) a fluid Subſtance, the only material Agent, or Mover, is a moderate Heat. Now how this, by producing an inteſtine Motion in the Particles of the Matter, which can be conceiv'd to differ in nothing elſe but Figure, Magnitude, and Gravity, ſhould, by Vertue thereof, not only ſeparate the Heterogeneous Parts, but aſſemble the Homogeneous into Maſſes, or Syſtems, and that not each Kind into one Maſs, but into many and disjoin'd Ones, as it were ſo many Troops; and that in each Troop the particular Particles ſhould take their Places, and caſt themſelves into ſuch a Figure; as for Example, the Bones, being about 300, are form'd of various Sizes and Shapes, ſo ſituate and connected, as to be ſubſervient to many hundred Intentions and Uſes, and many of them conſpire to one and the ſame Action, and all this contrarily to the Laws of Specifick Gravity, in whatever Poſture the Body be form'd; for the Bones, whoſe component Parts are the heavier, will be above ſome Parts of the Fleſh which are the lighter; how much more then, ſeeing it is form'd with the Head, (which for its Bigneſs is the heavieſt of all the Parts) uppermoſt. This, I ſay, I cannot by any Means conceive. I might inſtance in all the Homogeneous Parts of the Body, either Sites and Figures, and ask by what imaginable Laws of Motion their Bulk, Figure, Situation, and Connection can be made out? What Account can be given of the Valves, of the Veins and Arteries of the Heart, and of the Veins

elsewhere, and of their Situation; of the Figure and Consistency of all the Humours and Membranes of the Eye, all conspiring and exactly fitted to the Use of Seeing? But I have touch'd upon that already, and shall discourse it largely afterward. You will ask me, Who, or what, is the Operator in the Formation of the Bodies of Man; and other Animals? I answer, The sensitive Soul it self, if it be a spiritual and immaterial Substance, as I am inclinable to believe; but if it be material, and consequently the whole *Animal* but a mere Machine, or *Automaton*, as I can hardly admit, then must we have recourse to a *Plastick Nature*.

That the Soul of Brutes is material, and the whole Animal, Soul and Body, but a mere Machine, is the Opinion, publickly own'd and declar'd, of *Des Cartes*, *Gassendus*, Dr. *Willis*, and others. The same is also necessarily consequent upon the Doctrine of the Peripateticks, *viz.* That the sensitive Soul is educed out of the Power of the Matter; for nothing can be educed out of the Matter but what was there before; which must be either Matter, or some Modification of it. And therefore they cannot grant it to be a spiritual Substance, unless they will assert it to be educed out of nothing. This Opinion, I say, I can hardly digest: I should rather think, Animals to be endu'd with a lower Degree of Reason, than that they are mere Machines. I could instance in many Actions of *Brutes*, that are hardly to be accounted for without Reason and Argumentation; as that commonly

monly noted of Dogs, that running before their Masters, they will stop at a Divarication of the Way, 'till they see which Hand their Masters will take; and that when they have gotten a Prey, which they fear their Masters will take from them, they will run away and hide it, and afterwards return to it. What Account can be given why a Dog, being to leap upon a Table which he sees to be too high for him to reach at once, if a Stool, or Chair, happens to stand near it, doth first mount up that, and from thence the Table? If he was a Machine, or Piece of Clockwork, and this Motion caus'd by the striking of a Spring, there is no Reason imaginable why the Spring being set on Work, should not carry the Machine in a right Line toward the Object that put it in Motion, as well when the Table is high as when it is low; whereas I have often observ'd the first Leap the Creature hath taken up the Stool, not to be directly toward the Table, but in a Line oblique, and much declining from the Object that mov'd it, or that Part of the Table on which it stood.

Many the like Actions there are, which I shall not spend Time to relate. Should this be true, that Beasts were *Automata*, or Machines, they could have no Sense, or Perception of Pleasure, or Pain, and consequently no Cruelty could be exercis'd towards them; which is contrary to the doleful Significations they make when beaten, or tormented, and contrary to the common Sense of Mankind, all Men naturally pitying them, as apprehending them to have such a

Senſe and Feeling of Pain and Miſery as themſelves have; whereas no Man is troubled to ſee a Plant torn, or cut, or ſtampt, or mangled how you pleaſe; and at laſt ſeemingly contrary to the Scripture too; for it is ſaid, *Prov.* xii. 10. *A righteous Man regardeth the Life of his Beaſt, but the tender Mercies of the Wicked are cruel.* The former Clauſe is uſually Engliſh'd, *A good Man is merciful to his Beaſt*; which is the true Expoſition of it; as appears by the oppoſite Clauſe, that *the Wicked are cruel.* What leſs then can be inferr'd from this Place, than that Cruelty may be exercis'd towards Beaſts, which, were they mere Machines, it could not be? To which I do not ſee what can be anſwer'd, but that the Scripture accommodates it ſelf to the common, tho' falſe, Opinion of Mankind, who take theſe Animals to be endued with Senſe of Pain, and think that Cruelty may be exercis'd towards them; tho', in reality, there is no ſuch thing: Beſides, having the ſame Members and Organs of Senſe as we have, it is very probable they have the ſame Senſations and Perceptions with us. To this *Des Cartes* anſwers, or indeed ſaith, he hath nothing to anſwer; but that if they think as well as we, they have an immortal Soul as well as we: Which is not at all likely, becauſe there is no Reaſon to believe it of ſome Animals without believing it of all; whereas there are many too imperfect to believe it of them, ſuch as are *Oyſters*, and *Sponges*, and the like. To which I anſwer, That there is no Neceſſity they ſhould be immortal, be-

becauſe it is poſſible they may be deſtroy'd, or annihilated. But I ſhall not wade further into this Controverſy, becauſe it is beſide my Scope, and there hath been as much written of it already, as I have to ſay, by Dr. *Moore*, Dr. *Cudworth*, *Des Cartes*, Dr. *Willis*, and others, *Pro* and *Con*.

Of the viſible Works of God, and their Diviſion.

I come now to take a View of the Works of the Creation, and to obſerve ſomething of the Wiſdom of God diſcernable in the Formation of them, in their Order and Harmony, and in their Ends and Uſes: And firſt, I ſhall run them over ſlightly, remarking chiefly what is obvious and expos'd to the Eyes and Notice of the more careleſs and incurious Obſerver. Secondly, I ſhall ſelect one or two particular Pieces, and take a more exact Survey of them; tho' even in theſe, more will eſcape our Notice than can be diſcover'd by the moſt diligent Scrutiny; for our Eyes and Senſes, however arm'd or aſſiſted, are too groſs to diſcern the Curioſity of the Workmanſhip of Nature, or thoſe minute Parts by which it acts, and of which Bodies are compos'd; and our Underſtanding too dark and infirm to diſcover and comprehend all the Ends and Uſes to which the infinitely wiſe Creator did deſign them.

But before I proceed, being put in Mind thereof by the mention of the Aſſiſtance of our Eyes, I cannot omit one general Obſervation concerning the Curioſity of the Works of Nature

ture in Compariſon of the Works of Art, which I ſhall propoſe in the late Biſhop of *Cheſter*'s Words, (*Treatiſe of Natural Religion*, Lib. 1. c. 6.)
" The Obſervations which have been made in
" theſe latter Times by the Help of the *Micro-*
" *ſcope*, ſince we had the Uſe and Improvement
" of it, diſcover a vaſt Difference between Na-
" tural and Artificial Things. Whatever is Na-
" tural, beheld thro' that, appears exquiſitely
" form'd, and adorn'd with all imaginable Ele-
" gancy and Beauty. There are ſuch inimita-
" ble Glidings in the ſmalleſt Seeds of Plants,
" but eſpecially in the Parts of Animals, in the
" Head, or Eye, of a ſmall Fly; ſuch Accu-
" racy, Order, and Symmetry in the Frame of
" the utmoſt minute Creatures, a *Louſe*, for Ex-
" ample, or a *Mite*, as no Man were able to con-
" ceive without ſeeing of them. Whereas the
" moſt curious Works of Art, the ſharpeſt and
" fineſt Needle, doth appear as a blunt rough
" Bar of Iron, coming from the Furnace, or the
" Forge: The moſt accurate Engravings, or Em-
" boſments, ſeem ſuch rude, bungling, and de-
" form'd Work, as if they had been done with a
" Mattock, or Trowel; ſo vaſt a Difference is
" there betwixt the Skill of Nature, and the
" Rudeneſs and Imperfection of Art. I might
" add, that the Works of Nature, the better
" Lights and Glaſſes you uſe, the more clear
" and exactly form'd they appear; whereas the
" Effects of human Art, the more curiouſly they
" are view'd and examin'd, the more of Defor-
" mity they diſcover.

This

This being premiſed, for our more clear and diſtinct Proceeding in our curſory View of the Creation, I ſhall rank the Parts of this material and viſible World under ſeveral Heads. Bodies are either *inanimate* or *animate*. *Inanimate* Bodies are either *cæleſtial* or *terreſtrial*. *Cæleſtial*, as the *Sun*, *Moon*, and *Stars*; *Terreſtrial*, are either *ſimple*, as the four Elements, *Fire*, *Water*, *Earth*, and *Air*; or *mixt*, either *imperfectly*, as the *Meteors*, or more perfectly, as *Stones*, *Metals*, *Minerals*, and the like. *Animate* Bodies are either ſuch as are endued with a *Vegetative* Soul, as Plants; or a *Senſitive* Soul, as the Bodies of *Animals*, *Birds*, *Beaſts*, *Fiſhes*, and *Inſects*; or a *Rational* Soul, as the Body of *Man*, and the Vehicles of *Angels*, if any ſuch there be.

I make uſe of this Diviſion to comply with the common and receiv'd Opinion, and for eaſier Comprehenſion and Memory; tho' I do not think it agreeable to Philoſophick Verity and Accuracy, but do rather incline to the *Atomick Hypotheſis:* For theſe Bodies, we call *Elements*, are only the Ingredients of mix'd Bodies; neither are they abſolutely ſimple themſelves, as they do exiſt in the World, the Sea Water containing a copious Salt manifeſt to Senſe; and both Sea and Freſh-water ſufficing to nouriſh many Species of Fiſh, and conſequently containing the various Parts of which their Bodies are compounded. And I believe there are many Species of Bodies which the *Peripateticks* call mix'd, which are as ſimple as the *Elements* themſelves, as *Metals*, *Salts*, and ſome Sorts of *Stones*.

Stones. I ſhould therefore, with Dr. *Grew*, and others, rather attribute the various Species of inanimate Bodies to the divers Figures of the minute Particles of which they are made up: And the Reaſon why there is a Set, and conſtant Number, of them in the World, none deſtroy'd, nor any new ones produc'd, I take to be, becauſe the Sum of the Figures of thoſe minute Bodies into which Matter was at firſt divided, is determinate and fix'd. 2. Becauſe thoſe mimute Parts are indiviſible, not abſolutely, but by any natural Force; ſo that there neither is, nor can be, more or fewer of them: For were they diviſible into ſmall and diverſly-figur'd Parts by Fire, or any other natural Agent, the Species of Nature muſt be confounded, ſome might be loſt and deſtroy'd, but new ones would certainly be produc'd; unleſs we could ſuppoſe theſe new diminutive Particles ſhould again aſſemble and marſhal themſelves into Corpuſcles of ſuch Figures as they compounded before; which I ſee no Poſſibility for them to do, without ſome Θεὸς ἀπὸ μηχνῆς to direct them: Not that I think theſe inanimate Bodies to conſiſt wholly of one Sort of *Atoms*, but that their Bulk conſiſts mainly or chiefly of one Sort. But whereas it may be objected that Metals (which of all others ſeem to be moſt ſimple) may be tranſmuted one into another, and ſo the *Species* doth not depend upon the being compounded of *Atoms* of one Figure; I anſwer, I am not fully ſatisfied of the Matter of Fact: But if any ſuch Tranſmutation be, poſſibly all Metals may be of one Species,

Species, and the Diverſity may proceed from the Admixture of different Bodies with the Principles of the Metal. If it be ask'd, Why may not Atoms of different Species concur to the Compoſition of Bodies? And ſo, tho' there be but a few Sorts of original Principles, may there not be produced infinite Species of compound Bodies, as by the various Diſpoſitions and Combinations of Twenty-four Letters innumerable Words may be made up? I anſwer, becauſe the Heterogeneous Atoms or Principles are not naturally apt to cohere and ſtick together when they are mingled in the ſame Liquor, as the Homogeneous readily do.

I do not believe that the *Species* of Principles, or indiviſible Particles, are exceeding numerous; but poſſibly the immediate component Particles of the Bodies of Plants and Animals may be themſelves compounded.

Of the Heavenly Bodies.

Before I come to treat of the Heavenly Bodies in particular, I ſhall premiſe in general, that the whole Univerſe is divided into two Sorts of Bodies, the one very thin and fluid, the other more denſe, ſolid and conſiſtent. The thin and fluid is the *Ether*, comprehending the Air or Atmoſphere encompaſſing the particular Stars and Planets. Now, for the Stability and Perpetuity of the whole Univerſe, the Divine Wiſdom and Providence hath given to the ſolid and ſtable Parts a two-fold Power, one

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of Gravity, and the other of Circular Motion. By the firſt they are preſerv'd from Diſſolution and Diſſipation, which the ſecond would otherwiſe infer: For it being by the Conſent of Philoſophers, an innate Property of every Body mov'd circularly about any Centre, to recede, or endeavour to recede, from that Centre of its Motion, and the more ſtrongly the ſwifter it is mov'd, the Stars and Planets being whirl'd about with great Velocity, would ſuddenly, did nothing inhibit it, at leaſt in a ſhort Time, be ſhatter'd in Pieces, and ſcatter'd every Way thro' the *Ether*. But now their Gravity unites and binds them up faſt, hindring the Diſperſion of their Parts. I will not diſpute what Gravity is; only I will add, that, for ought I have heard, or read, the Mechanical Philoſophers have not as yet given a clear and ſatisfactory Account of it.

The ſecond Thing is a circular Motion upon their own *Axes*, and in ſome of them alſo, it's probable, about other Points, if we admit the *Hypotheſis* of every fix'd Stars being a Sun or Sun-like Body, and having a Choir of Planets in like Manner moving about him. Theſe Revolutions, we have Reaſon to believe, are as exactly equal and uniform as the Earth's are; which could not be, were there any Place for Chance, and did not a Providence continually over-ſee and ſecure them from all Alteration or Imminuation, which either internal Changes in their own Part, or external Accidents and Occurrences, would at one Time or other neceſſarily induce.

induce. Without this circular Motion of the Earth, here could be no living: One Hemisphere would be condemn'd to perpetual Cold and Darkneſs, the other continually roaſted and parch'd by the Sun-beams. And it is reaſonable to think, that this circular Motion is as neceſſary to moſt other Planetary Bodies, as it is to the Earth. As for the fix'd Stars, if they be Sun-like Bodies, it is probable alſo each of them moves circularly upon its own *Axis*, as the Sun doth: But what Neceſſity there is of ſuch a Motion, for want of underſtanding the Nature of thoſe Bodies, I muſt confeſs my ſelf not yet to comprehend; tho' that it is very great, I doubt not, both for themſelves, and for the Bodies about them.

Firſt, for the Celeſtial, or Heavenly Bodies, the Equability and Conſtancy of their Motions, the Certainty of their Periods and Revolutions, the Conveniency of their Order and Situations, argue them to be ordain'd and govern'd by Wiſdom and Underſtanding; yea, ſo much Wiſdom as Man cannot eaſily fathom or comprehend: For we ſee, by how much the *Hypotheſes* of Aſtronomers are more ſimple and conformable to Reaſon, by ſo much do they give a better Account of the Heavenly Motions. It is reported of *Alphonſus* King of *Arragon*, (I know not whether truly) that when he ſaw and conſider'd the many *Eccentricks*, *Epicycles*, *Epicycles* upon *Epicycles*, *Librations*, and Contrariety of Motions, which were requiſite in the old *Hypotheſis* to give an Account of the *Celeſtial*

ſtial Phænomena, he ſhould preſume blaſphemouſly to ſay, that the Univerſe was a bungling Piece; and that if he had been of God's Counſel, he could have directed him to have made it better. A Speech as raſh and ignorant, as daring and prophane.

For it was nothing but Ignorance of the true Proceſs of Nature, that induced the Contrivers of that *Hypotheſis* to invent ſuch abſurd Suppoſitions, and him to accept them for true, and attribute them to the great Author of the Heavenly Motions: For in the New *Hypotheſis* of the Modern Aſtronomers, we ſee moſt of thoſe Abſurdities and Irregularities rectify'd and remov'd; and I doubt not but they would all vaniſh, could we certainly diſcover the true Method and Proceſs of Nature in thoſe Revolutions: For ſeeing in thoſe Works of Nature which we converſe with, we conſtantly find thoſe Axioms true, *Natura non facit circuitus*, Nature doth not fetch a Compaſs when it may proceed in a ſtraight Line; and *Natura nec abundat in ſuperfluis, nec deficit in neceſſariis*, Nature abounds not in what is ſuperfluous, neither is deficient in what is neceſſary: We may alſo rationally conclude concerning the Heavenly Bodies, ſeeing there is ſo much Exactneſs obſerv'd in the Time of their Motions, that they punctually come about in the ſame Periods to the Hundredth Part of a Minute, as may, beyond Exception, be demonſtrated by comparing their Revolutions; ſurely there is alſo us'd the moſt ſimple, facile, and convenient Way for the

the Performance of them. Among these Heavenly Bodies,

First, the *Sun*, a vast Globe of Fire, esteem'd by the ancienter and most modest Computation above 160 Times bigger than the Earth; the very Life of this inferior World, without whole salutary and vivifick Beams all Motion, both Animal, Vital and Natural, would speedily cease, and nothing be left here below but Darkness and Death. All Plants and Animals must needs in a very short Time be not only mortified, but, together with the Surface of Land and Water, frozen as hard as a Flint or Adamant: So that of all the Creatures of the World, the ancient Heathens had most Reason to worship him as a God, tho' no true Reason; because he was but a Creature, and not God: And we Christians do think, that the Service of the Animals that live upon the Earth, and principally Man, was one End of his Creation; seeing without him there could no such Things have been. This *Sun*, I say, according to the old *Hypothesis*, whirl'd round about the Earth daily with incredible Celerity, making Night and Day by his rising and setting; Winter and Summer, by his Access to the several Tropicks, creating such a grateful Variety of Seasons, enlightning all Parts of the Earth by his Beams, and cherishing them by his Heat, situate and mov'd so in respect of this sublunary World, (and it's likely also in respect of all the Planets about him) that Art and Council could not have design'd either to have placed him better,

or mov'd him more conveniently for the Service thereof, as I could eafily make appear by the Inconveniences that would follow upon the Suppofition of any other Situation and Motion, fhew forth the great Wifdom of him who fo difpos'd and mov'd him.

Secondly, The *Moon*, a Body in all Probability fomewhat like the Earth we live upon, by its conftant and regular Motion, helps us to divide our Time, reflects the Sun-beams to us, and fo by illuminating the Air, takes away in fome Meafure the difconfolate Darknefs of our Winter-Nights; procures, or at leaft regulates, the Fluxes and Refluxes of the Sea, whereby the Water is kept in conftant Motion, and preferv'd from Putrefaction, and fo render'd more falutary for the Maintenance of its Breed, and ufeful and ferviceable for Man's Convenience of Fifhing and Navigation; not to mention the great Influence it is fuppos'd to have upon all moift Bodies, and the Growth and Increafe of Vegetables and Animals: Men generally obferving the Age of the *Moon* in the planting of all Kinds of Trees, fowing of Grain, grafting and inoculating, and pruning of Fruit-Trees, gathering of Fruit, cutting of Corn or Grafs; and thence alfo making Prognofticks of Weather, becaufe fuch Obfervations feem to me uncertain. Did this *Luminary* ferve to no other Ends and Ufes, as I am perfuaded it doth many, efpecially to maintain the Creatures which in all likelihood breed and inhabit there, for which I refer you to the ingenious Treatifes written by Bifhop *Wilkins*, and Monfieur

Monſieur *Fontenelle*, on that Subject; yet theſe were enough to evince it to be the Effect and Product of Divine Wiſdom and Power.

Thirdly, As for the reſt of the *Planets*, beſides their particular Uſes, which are to us unknown, or merely conjectural, their Courſes and Revolutions, their Stations and Retrogradations, obſerv'd conſtantly ſo many Ages together in moſt certain and determinate Periods of Time, do ſufficiently demonſtrate, that their Motions are inſtituted and govern'd by Counſel, Wiſdom and Underſtanding.

Fourthly, The like may be ſaid of the *fix'd Stars*, whoſe Motions are regular, equal and conſtant: So that we ſee nothing in the Heavens which argues Chance, Vanity, or Error; but on the contrary, Rule, Order, and Conſtancy; the Effects and Arguments of Wiſdom: Wherefore, as *Cicero* excellently concludes, *Cæleſtem ergo admirabilem ordinem, incredibilemque conſtantiam, ex qua converſatio & ſalus omnium omnis oritur, qui vacare mente putat, næ ipſe mentis expers habendus eſt:* "Wherefore whoſoever thinketh that the admirable Order, and "incredible Conſtancy, of the Heavenly Bodies, "and their Motions, whereupon the Preſervation and Welfare of all Things doth depend, is "not govern'd by Mind and Underſtanding, he "himſelf is to be accounted void thereof." And again, "Shall we (ſaith he) when we ſee an "Artificial Engine, as a Sphere or Dyal, or "the like, at firſt Sight acknowledge, that it is "a Work of Reaſon and Art? *Cum autem impe-*

tum cœli, admirabili cum celeritate moveri vertique videamus conſtantiſſimè conficientem viciſſitudines anniverſarias, cum ſummâ Salute & Conſervatione rerum omnium, dubitare quin ea non ſolum ratione fiant, ſed excellenti quâdam Divinâque ratione: " And can we, when we ſee the " Force of the Heavens mov'd and whirl'd about " with admirable Celerity, moſt conſtantly " finiſhing its anniverſary Viciſſitudes, to the " eminent Welfare and Preſervation of all " Things, doubt at all that theſe Things are " perform'd not only by Reaſon, but by a cer- " tain excellent and divine Reaſon?

To theſe Things I ſhall add an Obſervation, which I muſt confeſs my ſelf to have borrow'd of the honourable Perſon more than once mention'd already, that even the *Eclipſes* of the *Sun* and *Moon*, tho' they be frightful Things to the Superſtitious Vulgar, and of ill Influence on Mankind, if we may believe the no leſs ſuperſtitious Aſtrologers, yet to knowing Men, that can skilfully apply them, they are of great Uſe, and ſuch as common Heads could never have imagin'd: Since not only they may on divers Occaſions, help to ſettle *Chronology*, and rectifie the Miſtakes of *Hiſtorians* that writ many Ages ago; but which is tho' a leſs Wonder, yet of greater Utility, they are (as Things yet ſtand) neceſſary to define with competent Certainty, the Longitude of Places or Points on the Terraqueous Globe, which is a Thing of very great Moment not only to *Geography*, but to the moſt uſeful and impor-

tant Art of *Navigation*. To which may be added, which I ſhall hereafter mention, that they ſerve to demonſtrate the ſpherical Roundneſs of the Earth: So that I may well conclude with the Pſalmiſt, *Pſal.* xix. 1. *The Heavens declare the Glory of God, and the Firmament ſheweth his Handy-work.*

Of Terreſtrial and Inanimate Simple Bodies.

I come now to conſider the Terreſtrial Bodies. I ſhall ſay nothing of the whole Body of the Earth in general, becauſe I reſerve that as one of the Particulars I ſhall more carefully and curiouſly examine.

Terreſtrial Bodies, according to our Method before propounded, are either *inanimate*, or *animate*; and the *inanimate* either *ſimple*, or *mixt*; *Simple*, as the four Elements, *Fire*, *Water*, *Earth* and *Air*: I call theſe *Elements* in Compliance (as I ſaid before) with the vulgarly-receiv'd Opinion; not that I think them to be the Principles or component Ingredients of all other ſublunary Bodies: I might call them the four great Aggregates of Bodies of the ſame Species, or four Sort of Bodies, of which there are great Aggregates. Theſe, notwithſtanding they are endued with contrary Qualities, and are continually encroaching one upon another, yet they are ſo balanc'd, and kept in ſuch an *Equilibrium*, that neither prevaileth over other, but what one gets in one Place it loſeth in another.

Firſt, *Fire* cheriſheth and reviveth by its Heat, without which all Things would be tor-

pid, and without Motion, nay, without Fire, no Life, it being the vital Flame reſiding in the Blood that keeps the bodily Machine in Motion, and renders it a fit Organ for the Soul to work by. The Uſes of Fire (I do not here ſpeak of the Peripateticks Elementary Fire in the Concave of the Moon, which is but a mere Figment, but our ordinary Culinary) are in a Manner infinite for dreſſing and preparing of Victuals, bak'd, boil'd and roaſt; for melting and refining of Metals and Minerals; for the Fuſion of Glaſs, [a Material whoſe Uſes are ſo many, that it is not eaſy to enumerate them, it ſerving us to make Windows for our Houſes, Drinking-Veſſels, Veſſels to diſtil and preſerve all Sorts of fermented Liquors, diſtill'd Water, Spirits, Oils, Extracts, and other Chymical Preparations, as alſo Veſſels to diſtil and prepare them in; for Looking-Glaſſes, Spectacles, Microſcopes and Teleſcopes, whereby our Sight is not only reliev'd, but wonderfully aſſiſted to make rare Diſcoveries] for making all Sorts of Inſtruments for Husbandry, mechanick Arts and Trades, all Sorts of Arms or Weapons of War defenſive and offenſive; for fulminating Engines; for burning of Lime, baking of Bricks, Tiles, and all Sorts of Potters Veſſels, or earthen Ware; for caſting and forging Metaline Veſſels and Utenſils; for Diſtillations, and all Chymical Operations hinted before in the Uſe of Glaſs; for affording us Lights for any Work or Exerciſe in Winter-Nights; for digging in Mines and dark Caverns; and finally, by its comfortable Warmth

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ſecuring us from the Injuries of Cold, or relieving us when we have been bitten and benum'd with it. A Subject or Utenſil of ſo various and inexplicable Uſe, who could have invented and formed, but an infinitely wiſe and powerful Efficient?

Secondly, The *Air* ſerves us, and all Animals, to breathe in, containing the Fewel of that vital Flame we ſpeak of, without which it would ſpeedily languiſh and go out; ſo neceſſary it is for us, and other Land-Animals, that without the Uſe of it we could live but very few Minutes: Nay, Fiſhes and other Water-Animals cannot abide without the Uſe of it; for if you put Fiſh into a Veſſel of a narrow Mouth full of Water, they will live and ſwim there, not only Days and Months, but even Years; but if with your Hand, or any other Cover, you ſtop the Veſſel ſo as wholly to exclude the Air, or interrupt its Communication with the Water, they will ſuddenly be ſuffocated; as *Rondeletius* affirms he often experimented. If you fill not the Veſſel up to the Top, but leave ſome Space empty for the Air to take up, and then clap your Hand upon the Mouth of the Veſſel, the Fiſhes will preſently contend which ſhall get uppermoſt in the Water, that ſo they may enjoy the open Air; which I have alſo obſerv'd them to do in a Pool of Water that hath been almoſt dry in the Summer-Time, becauſe the Air that inſinuated it ſelf into the Water did not ſuffice them for Reſpiration. Neither is it leſs ne-

ceſſary for Inſects than it is for other Animals, but rather more, theſe having more Air-Veſſels for their Bulk by far than they, there being many Orifices on each Side their Bodies for the Admiſſion of Air, which if you ſtop with Oil or Honey, the Inſect preſently dies, and revives no more. This was an Obſervation of the Ancients, though the Reaſon of it they did not underſtand; *(Oleo illito Inſecta omnia exanimantur.* Plin.) which was nothing but the intercluding of the Air; for tho' you put Oil upon them, if you put it not upon, or obſtruct thoſe Orifices therewith, whereby they draw the Air, they ſuffer nothing: If you obſtruct only ſome, and not others, the Parts which are near and ſupplied with Air, from thence are by and by convulſed, and ſhortly relaxed and deprived of Motion, the reſt that were untouch'd ſtill retaining it. Nay, more than all this, Plants themſelves have a Kind of Reſpiration, being furniſh'd with Plenty of Veſſels for the Derivation of Air to all their Parts; as hath been obſerv'd, nay, firſt diſcover'd, by that great and curious Naturaliſt *Malpighius.* Another Uſe of the Air is to ſuſtain the Flight of Birds and Inſects. Moreover, by its Gravity it raiſes the Water in Pumps, Siphons, and other Engines, and performs all thoſe Feats which former Philoſophers, through Ignorance of the Efficient Cauſe, attributed to a Final, namely Nature's Abhorrence of a Vacuity or empty Space. The elaſtick or expanſive Faculty of the Air, whereby it dilates it ſelf, when compreſſed,

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(indeed this lower Region of it, by Reaſon of the Weight of the Superincumbent, is always in a compreſſed State) hath been made Uſe of in the common Weather-Glaſſes, in Wind-Guns, and in ſeveral ingenious Water-Works, and doubtleſs hath a great Intereſt in many natural Effects and Operations.

Againſt what we have ſaid of the Neceſſity of the Air for the Maintenance of the Vital Flame, it may be objected, That the *Fœtus* in the Womb lives, its Heart pulſes, and its Blood circulates; and yet it draws in no Air, neither hath the Air any Acceſs to it. To which I anſwer, That it doth receive Air, ſo much as is ſufficient for it in its preſent State, from the maternal Blood by the *Placenta Uterina*, or the *Cotyledons*. This Opinion generally propounded, *viz.* That the Reſpiration of the Dam did ſerve the *Fœtus* alſo, or ſupply ſufficient Air to it, I have met with in Books; but the explicit Notion of it I owe to my Learned and Worthy Friend Dr. *Edward Hulſe*, which, comparing with mine own Anatomical Obſervations, I found ſo conſonant to Reaſon, and highly probable, that I could not but yield a firm Aſſent to it. I ſay then, That the chief Uſe of the Circulation of the Blood through the *Cotyledons* of a Calf in the Womb, (which I have often diſſected) and by Analogy thro' the *Placenta Uterina* in an Human *Fœtus*, ſeems to be the Impregnation of the Blood with Air, for the Feeding of the *Vital Flame*: For if it were only for Nutrition, what Need of two ſuch great Arte-

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ries to convey the Blood thither? It would (one might rationally think) be more likely, that as in the *Abdomen* of every Animal, so here, there should have been some lacteal Veins form'd, beginning from the *Placenta*, or *Cotyledons*, which concurring in one common *Ductus*, should at last empty themselves into the *Vena Cava*. Secondly, I have observed in a Calf, the Umbilical Vessels to terminate in certain Bodies divided into a Multitude of carneous *Papillæ*, (as I may so call them) which are receiv'd into so many Sockets of the *Cotyledons* growing on the Womb; which carneous *Papillæ* may without Force, or Laceration, be drawn out of those Sockets. Now these *Papillæ* do well resemble the *Aristæ*, or *Radii*, of a Fish's Gills, and very probably have the same Use to take in the Air; so that the maternal Blood which flows to the *Cotyledons*, and encircles these *Papillæ*, communicates by them to the Blood of the *Fœtus*, the Air wherewith it self is impregnate; as the Water flowing about the carneous *Radii* of the Fish's Gills doth the Air that is lodg'd therein to them. Thirdly, That the maternal Blood flows most copiously to the *Placenta Uterina* in Women, is manifest from the great Hemorrhagy that succeeds the Separation thereof at the Birth. Fourthly, After the Stomach and Intestines are form'd, the *Fœtus* seems to take in its whole Nourishment by the Mouth, there being always found in the Stomach of a Calf, Plenty of the Liquor contain'd in the *Amnios* wherein he swims, and *Fæces* in his Intestines, and abundance

dance of Urine in the *Allantoides*; ſo that the *Fœtus* in the Womb doth live, as it were, the Life of a Fiſh. Laſtly, Why elſe ſhould there be ſuch an inſtant Neceſſity of Reſpiration ſo ſoon as ever the *Fœtus* is fallen off from the Womb.

I know that if the *Fœtus* be taken out of the Womb inclos'd in the Secundines, it will continue to live, and the Blood to circulate for a conſiderable Time, as Dr. *Harvey* obſerves. The Reaſon whereof I conceive to be, becauſe the Blood ſtill circulates through the *Cotyledons*, or *Placenta*, which are now expos'd to the open Air, and ſo from thence receives ſufficient Supplies thereof, to continue its gentle Motion, and feed the vital Flame. But when, upon Excluſion of the Young, the Umbilical Veſſels are broken, and no more Air is receiv'd that Way, the Plaſtick Nature, to preſerve the Life of the Animal, ſpeedily raiſes the Lungs, and draws into them Air in great abundance, which cauſes a ſudden and mighty Accenſion in the Blood; to the Maintenance whereof a far greater Quantity of Air is requiſite, than would ſerve to feed the mild and languid Flame before.

This Way we may give a facile and very probable Account of it, to wit, becauſe receiving no more Communications of Air from its Dam, or Mother, it muſt needs have a ſpeedy Supply from without, or elſe extinguiſh and die for Want of it; being not able to live longer without

without Air at its firſt Birth, than it can do afterward.

Upon this Occaſion, give me leave to diſcourſe a little concerning the Air's inſinuating it ſelf into the Water. I ſay therefore, That the Air, at leaſt that Part of it which is the Aliment of Fire, and Fewel of the Vital Flame in Animals, eaſily penetrates the Body of Water expos'd to it, and diffuſeth it ſelf through every Part of it. Hence it is that we find Fiſh in ſubterraneous Rivers, and foſſil Fiſh in the Earth it ſelf; which can no more live without Air there than in the open Waters: Hence the Miners, when they come once at Water, are out of all Dangers and Damps. You'll ſay, How gets the Air into the Water in Subterraneous Rivers, and into the Earth to the foſſil Fiſhes? I anſwer, The ſame Way that the Water doth: Which I ſuppoſe to be by its upper Superficies; the Water deſcending by Pores and Paſſages that there it finds into Chinks and Veins, and by Confluence of many of them by Degrees ſwelling into a Stream, the Air accompanies and follows it by a conſtant Succeſſion. As for foſſil Fiſhes, ſome make their Way into the Earth up the Veins of Water, opening into the Banks of Rivers, where they lie till they grow ſo great that they cannot return: In which Veins they find Air enough to ſerve their Turn, needing not much by reaſon that they lie ſtill, and move but little. Others in Times of Floods are left in the Meadows, and with the Water ſink into the Earth

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at ſome Holes and Pores that the Water finds, or makes, by which alſo they are ſupplied with Air. The Reaſon why the Miners are out of Danger of Damps when they come to Water, I conceive is, becauſe then preſently the Air that ſtagnated in the Shaft ſinks into the Water, and freſh Air deſcends and ſucceeds, and ſo there is a Circulation; in the ſame Manner as by the ſinking of an Air-Shaft the Air hath Liberty to circulate, and carry out the Steams both of the Miners Breath and the Damps, which would otherwiſe ſtagnate there. Indeed, though there were no Damps, yet the nitrous Part of the Air being ſpent and conſum'd by the Breathing of the Miners, the remaining Part ſhould be render'd altogether unfit for Reſpiration, unleſs new and freſh Air could ſucceed.

And here, methinks, appears a Neceſſity of bringing in the Agency of ſome ſuperintendent intelligent Being, be it a *Plaſtick Nature*, or what you will: For what elſe ſhould put the Diaphragm, and all the Muſcles ſerving to Reſpiration, in Motion all of a ſudden ſo ſoon as ever the *Fœtus* is brought forth? Why could they not have reſted as well as they did in the Womb? What aileth them that they muſt needs beſtir themſelves to get in Air to maintain the Creature's Life? Why could they not patiently ſuffer it to die? That the Air of it ſelf could not ruſh in, is clear; for that, on the contrary, there is requir'd ſome Force to remove the incumbent Air, and make room for the External to enter. You will ſay, the Spirits do at this

Time

Time flow to the Organs of Reſpiration, the Diaphragm, and other Muſcles which concur to that Action, and move them. But what rouſes the Spirits, which were quieſcent during the Continuance of the *Fœtus* in the Womb? Here is no appearing Impellent but the External Air, the Body ſuffering no Change but of Place, out of its cloſe and warm Priſon into the open and cool Air: But how, or why, that ſhould have ſuch an Influence upon the Spirits, as to drive them into thoſe Muſcles electively, I am not ſubtil enough to diſcern. As for the Reſpiration of the Chick in the Egg, I ſuppoſe the Air not only to be included in the White, but alſo to be ſupply'd through the Shell and Membranes.

Thirdly, *Water* is one Part, and that not the leaſt of our Suſtenance, and that affords the greateſt Share of Matter in all Productions; being not (as it exiſts in the World) a ſimple and unmix'd Body, but containing in it the Principles, or minute component Particles of all Bodies: To ſpeak nothing of thoſe inferiour Uſes of Waſhing and Bathing, dreſſing and preparing Victuals. But if we ſhall conſider the great *Concepticula* and Congregations of Water, and the Diſtribution of it all over the dry Land in Springs and Rivers, there will occur abundant Arguments of Wiſdom and Underſtanding. The Sea, what infinite Variety of Fiſhes doth it nouriſh! *Pſal.* civ. 25. In the Verſe next to my Text, *The Earth is full of thy Riches; So is this great and wide Sea, wherein are Things creeping*

creeping innumerable, both ſmall and great Beaſts, &c. How doth it exactly compoſe it ſelf to a Level, or equal Superficies, and in the Earth make up one Spherical Roundneſs? How doth it conſtantly obſerve its Ebbs and Flows, its Spring and Nepe-tides, and ſtill retains its Saltneſs, ſo convenient for the Maintenance of its Inhabitants, ſerving alſo the Uſes of Man for Navigation, and the Convenience of Carriage? That it ſhould be confined by Shores, and Strands, and Limits, I mean at firſt, when it was natural to it to overflow and ſtand above the Earth. All theſe Particulars declare abundance of Wiſdom in their Primitive Conſtitution. This laſt the Pſalmiſt takes Notice of in the 6th, 7th, 8th, and 9th Verſes of this *Pſalm:* Speaking of the Earth at the firſt Creation, he ſaith, *Thou coverd'ſt it with the Deep as with a Garment, the Waters ſtood above the Mountains: At thy Rebuke they fled, at the Voice of thy Thunder they haſted away* (*the Mountains aſcend, the Valleys deſcend*) *unto the Place thou haſt prepared for them. Thou haſt ſet a Bound that they may not paſs over: That they turn not again to cover the Earth.* But what Need was there (may ſome ſay) that the Sea ſhould be made ſo large, that its *Superficies* ſhould equal, if not exceed, that of the dry Land? Where is the Wiſdom of the Creator in making ſo much uſeleſs Sea, and ſo little dry Land, which would have been far more beneficial and ſerviceable to Mankind? Might not at leaſt half the Sea have been ſpar'd, and added to the Land, for the Entertainment

and Maintenance of Men, who by the continual Striving and Fighting to enlarge their Bounds, and encroaching upon one another, ſeem to be ſtraitned for want of Room.

To this Objection againſt the Wiſdom of God in thus dividing *Sea* and *Land*, Mr. *Keill*, in his *Examination of Dr.* Burnet's *Theory of the Earth*, p. 92, 93. thus anſwers: *This, as moſt other of the Atheiſts Arguments, proceeds from a deep Ignorance of Natural Philoſophy; for if there were but half the Sea that now is, there would be alſo but half the Quantity of Vapours, and conſequently we could have but half ſo many Rivers as now there are to ſupply all the dry Land we have at preſent, and half as much more; for the Quantity of Vapours which are rais'd, bears a Proportion to the Surface whence they are rais'd, as well as to the Heat which rais'd them. The Wiſe Creator therefore did ſo prudently order it, that the Sea ſhould be large enough to ſupply Vapours ſufficient for all the Land, which it would not do if it were leſs than now it is.*

But againſt this it may be objected, Why ſhould not all the Vapours which are rais'd out of the Sea fall down again into it by Rain? Is there not as much Reaſon that the Vapours which are exhaled out of the Earth ſhould be carried down to the Sea, as that thoſe raiſed out of the Sea be brought up upon the dry Land? If ſome by Winds be driven from the Sea up Land, others by the ſame Cauſe will be blown down from Land to Sea, and ſo balancing one another, they will in Sum fall equally

equally upon Sea and Land; and consequently the Sea contribute nothing to the Watering of the Earth, or the Maintenance of Rivers.

To which I answer, That as to the Watering of the Earth there needs no Supply from the Sea, there being sufficient Water exhaled out of it self to do that; there is no more return'd upon it by Rain, so as to rest upon it, than an equivalent Quantity to what was rais'd out of it.

But the Rivers must be supply'd other ways. Our Opinion is, that they have their Supply from Rain and Vapours. The Question is, Whence these Vapours are brought? We answer, From the Sea. But what brings them up from the Sea? I answer, The Winds: And so I am arrived at the main Difficulty, Why should not the Winds carry them that are exhaled out of the *Earth* down to the *Sea*, as well as bring them up upon the Earth, which are rais'd from the Sea? Or, which is all one, why should not the Wind blow indifferently from Sea and Land? To which I answer, That I must needs acknowledge my self not to comprehend the Reason hereof. God is truly said, *Psal.* cxxxv. 7. *To bring the Wind out of his Treasures.* But the Matter of Fact is most certain, *viz.* That the Winds do bring abundantly more Vapours up from the Sea than they carry down thither.

First, Because otherwise there can no Account be given of *Floods*. It is clear, That Floods with us proceed from Rain; and it is often a vast Quantity of Water they carry down

to the Sea. Whence come those Vapours which supply all this Water? I hope those who bring up Springs and Rivers from the great *Abyss*, will not bring those Vapours, which unite into Drops, and descend in Rain from thence too. Should they rise from the dry Land only, they would soon render it dry indeed; more parch'd than the Deserts of *Libya*. We should quickly come to an End of Floods, and of Rain too, if nothing were return'd from the Sea again; not to mention, that the Sea must needs in such a Case overflow its Shores, and enlarge its Bounds.

But this Way there is an easy Account to be given. It is clear, that the Sun doth exhale Vapours both from Sea and Land; and that the Superficies of Sea and Land is sufficient to yield Vapours for Rain, Rivers and Floods, when heated to such a Degree as the Sun heats it: So that there wants only Wind to bring up so great a Proportion of Vapours from the Sea as may afford Water for the Floods; that is, so much as is return'd back again to the Sea.

Some may perchance demand, To what Purpose serve the Floods? What Use is there of them? I answer, To return back to the Sea the Surplusage of Water after the Earth is sated with Rain. It may be further ask'd, What need more Rain be poured upon the Earth than is sufficient to water it? I reply, That the Rain brings down from the Mountains and higher Grounds a great Quantity of Earth, and in Times of Floods spreads it upon the Meadows and Levels, rendering them thereby so fruitful as to

ſtand in need of no Culture, or Manuring. So we ſee the Land of *Egypt* owes its great Fertility to the annual Overflowing of the River *Nilus:* And it's likely the Countries bordering upon the River of *Ganges* may receive the like Benefit by the Overflowing thereof. Moreover all Rain-Water contains in it a copious Sediment of Terreſtrial Matter, which by ſtanding it precipitates, and is not a ſimple Elementary Water. This Terreſtrial Matter ſerves for the Nouriſhment of Plants, and not the Water it ſelf, which is but a Vehicle to derive this Nutriment to all the Parts of the Plants: And therefore the more Rain, the more of this Nutricious Matter may be precipitated upon the Earth, and ſo the Earth render'd more fruitful. Beſides all this, it's not unlikely, that the Rain-Water may be endued with ſome Vegetating or Prolifick Virtue, deriv'd from ſome Saline or Oleoſe Particles it contains: For we ſee, that Aquatick Plants, which grow in the very Water, do not thrive and flouriſh in dry Summers, when they are not alſo water'd with the Dew of Heaven.

Secondly, Another Argument to prove, That the Winds bring up more Vapours from the Sea than they carry down thither, is, Becauſe the Winds do more frequently blow from the Sea than to the Sea. This appears from the Trees which grow on and near the Sea-ſhores all along the Weſtern Coaſt of *England*, whoſe Heads and Boughs I have obſerv'd to run out far to Landward; but toward the Sea to be ſo ſnub'd by the

Winds, as if their Boughs and Leaves had been pared or ſhaven off on that Side.

It is alſo obſerv'd, that the Weſtern Wind, which is the moſt violent and boiſterous of all with us in *England*, which comes from off the great *Atlantick* Ocean, is of longeſt Continuance. *Julius Cæſar*, in his 5th Book of *Commentaries de Bello Gallico*, ſaith of it, *Magnam partem omnis temporis in his locis fluere conſuevit*; it is wont to blow in theſe Quarters a great Part of the whole Year: Which Obſervation holds true at this Day, the Wind lying in that Corner at leaſt three Quarters of the Year.

Since this Motion of the Winds is conſtant, there is doubtleſs a conſtant and ſettled Cauſe of it, which deſerves to be enquir'd into, and ſearch'd out, by the Study and Endeavours of the moſt ſagacious Naturaliſts. But however the Wind be rais'd, it may more eaſily blow from Sea to Land, than from Land to Sea, becauſe the Superficies of the Sea being even, or level, there is nothing to ſtop its Courſe; but on the Land there are not only Woods, but Mountains to hinder and divert it,

Having my ſelf ſeen ſo much of the Bottom of the Sea round about the Coaſts of *England*, and a great Part of the *Low Countries*, of *Italy* and *Sicily*, I muſt needs adhere to what I deliver'd, That where the Bottom of the Sea is not Rocky, but Earth, Owze, or Sand, and that is incomparably the greateſt Part of it, it is by the Motion of the Waters, ſo far as the Reciprocation of the Sea extends to the Bottom, brought

to a Level; and if it ſhould be now unequal, would in Time be level'd again. By Level I do not mean ſo as to have no Declivity (for the Reciprocation preſerves that, the Flood hindering the conſtant carrying down of the Bottom) but only to have an equal and uniform Deſcent from the Shores to the Deeps. Now all thoſe Relations of Urinators belong only to thoſe Places where they have dived, which are always rocky; for there is no Reaſon why they ſhould dive where the Bottom is level and ſandy. That the Motion of the Water deſcends to a good Depth, I prove from thoſe Plants that grow deepeſt in the Sea, becauſe they all generally grow flat, in Manner of a Fan, and not with Branches on all Sides like Trees, which is ſo contriv'd by the Providence of Nature; for that the Edges of them do in that Poſture with moſt Eaſe cut the Water flowing to and fro; and ſhould the flat Side be objected to the Stream, it would ſoon be turn'd Edge-wiſe by the Force of it, becauſe in that Site it doth leaſt reſiſt the Motion of the Water: Whereas, did the Branches of theſe Plants grow round, they would be thrown backward and forward every Tide. Nay, not only the Herbaceous and Woody Submarine Plants, but alſo the * *Lithophyta* themſelves, affect this manner of growing, as I have obſerv'd in various Kinds of *Corals* and *Pori*. Hence I ſuſpect all thoſe Relations concerning Trees growing at the Bottom of the Sea, and bringing forth Fruit there: And as for the *Maldiva Nut*, till better Information, I adhere

* Stone-Plants.

to *Garcias*'s Opinion, which may be seen in *Clusius*. Farther, I do believe, that in the great Depths of the Sea, there grow no Plants at all, the Bottom being too remote from the External Air, which though it may pierce the Water so low, yet I doubt whether in Quantity sufficient for the Vegetation of Plants: Nay, we are told, That in those deep and bottomless Seas there are no Fish at all; yet, not because there are no Plants, or Insects, to feed them, for that they can live upon Water alone, *Rondeletius*'s Experiment about keeping them in a Glass doth undeniably prove, but because their Spawn would be lost in those *Seas*, the Bottom being too cold for it to quicken there, or rather because being lighter than the Water there, it would not sink to the Bottom, but be buoy'd up by it, and carried away to the Shallows.

Again, The great Use and Convenience, the Beauty and Variety of so many Springs and Fountains, so many Brooks and Rivers, so many Lakes and standing Pools of Water, and these so scatter'd and dispers'd all the Earth over, that no great Part of it is destitute of them, without which it must, without a Supply otherways, be desolate and void of Inhabitants, afford abundant Arguments of Wisdom and Council: That Springs should break forth on the Sides of Mountains most remote from the Sea: That there should Way be made for Rivers thro' Straits and Rocks, and subterraneous Vaults, so that one would think that Nature had cut a Way on Purpose to derive the Water, which else would

would overflow and drown whole Countries: That the Water passing thro' the Veins of the Earth, should be rendred fresh and potable, which it cannot be by any Percolations we can make, but the Saline Particles will pass through a tenfold Filtre: That in some Places there should spring forth Metalick and Mineral Waters, and hot Baths, and these so constant and permanent for many Ages; so convenient for divers Medicinal Intentions and Uses, the Causes of which Things, or the Means and Methods by which they are perform'd, have not been as yet certainly discover'd; only in General, *Pliny*'s Remark may be true, *Tales sunt aquæ, qualis terra per quam fluunt.* Hence they are Cold, Hot, Sweet, Stinking, Purgative, Diuretick, or Ferrugineous, Saline, Petrefying, Bituminose, Venenose, and of other Qualities.

Lastly, The *Earth*, which is the Basis and Support of all Animals and Plants, and affords them the hard and solid Part of their Bodies, yielding us Food and Sustenance, and partly also Cloathing; for I do not think that Water supplies Man, and other Animals, or even Plants themselves, with their Nourishment, but serves chiefly for a Vehicle to the Alimentary Particles, to convey and distribute them to the several Parts of the Body. Water, as it exists in the World, is not a simple unmix'd Body, but contains the Terrestrial component Parts of the Bodies of Animals and Plants: Simple Elementary Water nourishes not at all. How variously is the Surface of this

Earth distinguish'd into Hills, and Valleys, and Plains, and high Mountains, affording pleasant Prospects? How curiously cloath'd and adorn'd with the grateful Verdure of Herbs and stately Trees, either dispers'd and scatter'd singly, or as it were assembled in Woods and Groves, and all these beautified and illustrated with Elegant Flowers and Fruits, *quorum omnium incredibilis multitudo, insatiabili varietate distinguitur*, as *Tully* saith. This also shews forth to them that consider it, both the Power and Wisdom of God: So that we may conclude with *Solomon*, Prov. iii. 19. *The Lord by Wisdom hath founded the Earth, by Understanding hath he establish'd the Heavens.*

But now, if we pass from Simple to Mix'd Bodies, we shall still find more Matter of Admiration, and Argument of Wisdom. Of these we shall first consider those they call imperfectly Mix'd, or *Meteors.*

Of METEORS.

As first of all, *Rain*, which is nothing else but Water, by the Heat of the Sun divided into very small invisible Parts, ascending in the Air, till encountring the Cold, it be by Degrees condens'd into Clouds, and descends in Drops; this though it be exhaled from the Salt Sea, yet by this Natural Distillation is render'd fresh and potable, which our Artificial Distillations have hitherto been hardly able to effect, notwithstanding the eminent Use it would be of to Navigators, and the Rewards promis'd to those that should

ſhould reſolve that Problem of diſtilling freſh Water out of Salt. That the Clouds ſhould be ſo carried about by the Winds, as to be almoſt equally diſperſed and diſtributed, no Part of the Earth wanting convenient Showers, unleſs when it pleaſeth God, for the Puniſhment of a Nation, to with-hold Rain by a ſpecial Interpoſition of his Providence; or, if any Land wants Rain, they have a Supply ſome other way; as the Land of *Egypt*, tho' there ſeldom falls any Rain there, yet hath abundant Recompence made it by the annual overflowing of the River. This Diſtribution of the Clouds and Rain is to me (I ſay) a great Argument of Providence and divine Diſpoſition; for elſe I do not ſee but why there might be in ſome Lands continual ſucceſſive Droughts for many Years, till they were quite depopulated; in others as laſting Rains, till they were overflown and drown'd; and theſe, if the Clouds mov'd caſually, often happening; whereas, ſince the ancienteſt Records of Hiſtory, we do not read or hear of any ſuch Droughts or Inundations, unleſs perhaps that of *Cyprus*, wherein there fell no Rain there for Thirty-ſix Years, till the Iſland was almoſt quite deſerted, in the Reign of *Conſtantine*; which doubtleſs fell not out without the wiſe Diſpoſition of Providence, for great and weighty Reaſons.

Again, If we conſider the manner of the Rain's Deſcent, diſtilling down gradually, and by Drops, which is moſt convenient for the watering of the Earth; whereas if it ſhould fall down

in

in a continual Stream like a River, it would gall the Ground, wash away Plants by the Roots, overthrow Houses, and greatly incommode, if not suffocate Animals: If, I say, we consider these Things, and many more that might be added, we might in this respect also cry out with the Apostle, *O the Depth of the Riches both of the Wisdom and Knowledge of God!*

Secondly, Another Meteor is the *Wind*; which how many Uses it doth serve to, is not easy to enumerate, but many it doth, *viz.* to ventilate and break the Air, and dissipate noisom and contagious Vapours, which otherwise stagnating, might occasion many Diseases in Animals; and therefore it is an Observation concerning our native Country, *Anglia ventosa, si non ventosa, venenosa:* To transfer the Clouds from Place to Place, for the more commodious watering of the Earth: To temper the Excesses of the Heat, as they find who in *Brasil*, *New Spain*, the neighbouring Islands, and other the like Countries near the Equator, reap the Benefit of the Breezes: To fill the Sails of Ships, and carry them on their Voyages to remote Countries; which, of what eminent Advantage it is to Mankind, for the procuring and continuing of Trade and mutual Commerce between the most distant Nations, the illustrating every Corner of the Earth, and the perfecting Geography and Natural History, is apparent to every Man. That the Monsoons and Trade-Winds should be so constant and periodical, even to the 30th Degree of Latitude all round the Globe, and that they should

ſhould ſo ſeldom tranſgreſs or fall ſhort of thoſe Bounds, is a Subject worthy of the Thoughts of the greateſt Philoſophers. To this may be added the driving about of Windmills for grinding of Corn, making of Oil, draining of Pools, raiſing of Water, ſawing of Wood, fulling of Cloth, *&c.* That it ſhould ſeldom or never be ſo violent and boiſterous as to overturn Houſes, yea, whole Cities; to tear up Trees by the Roots, and proſtrate Woods; to drive the Sea over the lower Countries; as, were it the Effect of Chance, or mere natural Cauſes, not moderated by a ſuperior Power, it would in all likelihood often do. Hurricanes, Spouts, and Inundations, would be more frequent than they are. All theſe Things declare the Wiſdom and Goodneſs of him *who bringeth the Wind out of his Treaſures.*

Of inanimate mix'd Bodies.

I proceed now to ſuch inanimate Bodies as are called *perfectè mixta*, perfectly mix'd, improperly enough, they being many of them (for ought I know) as ſimple as thoſe they call Elements. Theſe are *Stones*, *Metals*, *Minerals*, and *Salts*.

In *Stones*, which one would think were a neglected *Genus*, what Variety? what Beauty and Elegancy? what Conſtancy in their Temper, and Conſiſtency in their Figures and Colours? I ſhall ſpeak of firſt ſome notable Qualities wherewith ſome of them are endued: Secondly, The remarkable Uſes they are of to us. The Qualities

I ſhall

I ſhall inſtance in are: Firſt, *Colour*, which in ſome of them is moſt lively, ſparkling, and beautiful; the *Carbuncle*, or *Rubine* ſhining with Red, the *Sapphire* with Blue, the *Emerald* with Green, the *Topaz*, or *Chryſolite of the Ancients*, with a Yellow, or Gold Colour, the *Amethiſt* as it were tinctur'd with Wine, the *Opal* varying its Colours like changeable Taffata, as it is diverſly expos'd to the Light. Secondly, *Hardneſs*, wherein ſome Stones exceed all other Bodies, and among them the *Adamant* all other Stones, being exalted to that degree thereof, that Art in vain endeavours to counterfeit it, the fictitious Stones of Chymiſts in Imitation being eaſily detected by an ordinary Lapidiſt. Thirdly, *Figure:* Many of them ſhoot into regular Figures, as *Cryſtal* and *Baſtard Diamonds* into hexagonal; others into thoſe that are more elegant and compounded, as thoſe formed in Imitation of the Shells of Teſtaceous Fiſhes of all Sorts, Sharks Teeth and Vertebres, *&c.* if theſe be originally Stones, or primary Productions of Nature in Imitation of Shells, and Fiſhes Bones, and not the Shells and Bones themſelves petrify'd, as we have ſometimes thought. Some have a kind of Vegetation and Reſemblance of Plants, as *Corals*, *Pori*, and *Fungites*, which grow upon the Rocks like Shrubs: To which I might add our ordinary *Star-Stones* and *Trochites*, which I look upon as a Sort of Rock-Plants.

Secondly,

Secondly, For the Uſes; ſome ſerve for Building, and many Sorts of Veſſels and Utenſils; for Pillars and Statues, and other carv'd Works in *relievo*, for the Temples, Ornament of Palaces, Portico's, Piazza's, Conduits, *&c.* as Freeſtone and Marble; ſome to burn into Lime, as Chalk and Lime-ſtone; ſome, with the Mixture of *Beriglia* or *Kelp*, to make Glaſs, as that the *Venetians* call *Cuogulo*, and common Flints, which ſerve alſo to ſtrike Fire; ſome to cover Houſes, as Slates, ſome for marking, as *Morochthus*, and the fore-mention'd Chalk, which is a πολύχρηστον, ſerving moreover for manuring Land, and ſome medicinal Uſes; ſome to make Veſſels of which will endure the Fire, as that found in the Country of *Chiavenna* near *Plurs*. To theſe uſeful Stones I might add the *Warming-ſtone*, digg'd in *Cornwall*, which being once well heated at the Fire, retains its Warmth a great while, and hath been found to give Eaſe and Relief in ſeveral Pains and Diſeaſes, particularly in that of the internal Hæmorrhoids. I might alſo take notice, that ſome Stones are endu'd with an *electrical* or attractical Virtue. " My honour'd Friend, " Dr. *Tancred Robinſon*, in his Manuſcript *Itinerary of Italy*, relates the many various Figures he obſerv'd naturally delineated and " drawn on ſeveral Sorts of Stones digg'd up in " the Quarries, Caverns and Rocks about *Florence*, and other Parts of *Italy*, not only repreſenting Cities, Mountains, Ruins, Clouds, " oriental Characters, Rivers, Woods, Animals,

" but

" but alſo ſome Plants (as Ivy, Moſſes, Maiden-
" hair, Ferns, and ſuch Vegetables as grow in
" thoſe Places) ſo exactly deſign'd and impreſs'd
" upon ſeveral Kinds of Stones, as though ſome
" ſkilful Painters or Sculptors had been working
" upon them. The *Doctor* obſerves alſo the
" wonderful Diverſity of Shapes and Colours
" that Oars and other Foſſils ſhoot into, reſem-
" bling almoſt every thing in Nature, for which
" it ſeems very difficult to him to aſſign any
" Cauſe or Principle. In the *Pyrites* alone he
" believes he himſelf may have ſeen at Home
" and Abroad above a Hundred Varieties, and
" yet he confeſſes he has been but a rude Obſer-
" ver of them. In the diaphanous Foſſils (as
" Ambers, Cryſtals, Agates, *&c.*) preſerv'd in
" the Cabinets of the Great Duke of *Tuſcany*,
" Cardinal *Chigi*, *Settali*, *Moſcardi*, and other
" Repoſitories or Muſæums of that curious
" Country, he takes notice of the admirable Di-
" verſity of Bodies included and naturally im-
" priſon'd within them, as Flies, Spiders, Frogs,
" Locuſts, Bees, Piſmires, Gnats, Graſhoppers,
" Drops of Liquor, Hair, Leaves, Ruſhes, Moſs,
" Seeds, and other Herbage; which ſeem to
" prove them to have been once in a State of
" Fluidity. The *Bononia* Stone digg'd up in the
" *Appenines* is remarkable for its ſhining Quali-
" ty. The *Amianthus* for its Incumbuſtibility.
" The *Oculus Mundi* for its Motion and Change
" of Colour. The *Lapis Nephriticus*, *Calamina-
" ris*, *Oſtiocolla*, *Ætites*, *&c.* for their medicinal
" Uſes."

I might

I might ſpend much Time in the diſcourſing of the moſt ſtrange and unaccountable Nature and Power of the Loadſtone, a Subject which hath exercis'd the Wits and Pens of the moſt acute and ingenious Philoſophers; and yet the *Hypotheſes* which they have invented to give an Account of its admirable *Phænomena* ſeem to me lame and unſatisfactory. What can we ſay of the Subtilty, Activity, and Penetrancy of its *Effluvia*, which no Obſtacle can ſtop or repel, but they will make their way thro' all Sorts of Bodies, firm and fluid, denſe and rare, heavy and light, pellucid and opake? nay, they will paſs thro' a Vacuity or empty Space, at leaſt devoid of Air and any other ſenſible Body. Its attractive Power of Iron was known to the Ancients: Its Verticity and Direction to the Poles of the Earth is of later Invention; which, of how infinite Advantage it hath been to theſe two or three laſt Ages, the great Improvement of Navigation, and Advancement of Trade and Commerce, by rendring the remoteſt Countries eaſily acceſſible; the noble Diſcovery of a vaſt Continent or new World, beſides a Multitude of unknown Kingdoms and Iſlands; the reſolving experimentally thoſe ancient Problems of the ſpherical Roundneſs of the Earth; of the Being of *Antipodes*, or the Habitableneſs of the *Torrid Zone*; and the rendring the whole terraqueous Globe circumnavigable, do abundantly demonſtrate: whereas formerly they were wont to Coaſt it, and creep along the Shores, ſcarce daring to venture out of the

the Ken of Land; when they did, having no other Guide but the *Cynosura*, or Pole-Star, and those near it, and in cloudy Weather none at all.

As for *Metals*, they are so many ways useful to Mankind, and those Uses so well known to all, that it would be lost Labour to say any thing of them: Without the Use of these we could have nothing of Cultule or Civility; no Tillage or Agriculture; no Reaping or Mowing; no Ploughing or Digging; no Pruning or Lopping, Grafting, or Incision; no mechanical Arts or Trades; no Vessels or Utensils of Houshold-stuff; no convenient Houses or Edifices; no Shipping or Navigation. What a kind of barbarous and sordid Life we must necessarily have liv'd, the *Indians* in the northern Part of *America* are a clear Demonstration. Only it is remarkable, that those which are of most frequent and necessary Use, as Iron, Brass, and Lead, are the most common and plentiful: Others that are more rare, may better be spar'd, yet are they thereby qualified to be made the common Measure and Standard of the Value of all other Commodities, and so serve for Coin or Money, to which Use they have been employ'd by all Civil Nations in all Ages.

Now of what mighty Importance the Use of Money is to Mankind, the learned and ingenious Dr. *Cockburn* shews us, in the *Second Part* of his *Essay* concerning the *Nature of Christian Faith*, *p.* 88. Whenever, saith he, the Use of Money began, it was an admirable Contrivance for rewarding and encouraging Industry, for

for carrying on Trade and Commerce certainly, eaſily, and ſpeedily; for obliging all to employ their various Parts and ſeveral Capacities for the common Good, and engaging every one to communicate the Benefit of his particular Labour, without any Prejudice to himſelf. Covetouſneſs indeed, or an inordinate Love of Money, is vicious, and the Root of much Evil, and ought to be remedied; but the Uſe of Money is neceſſary, and attended with manifold Advantages. Where Money has not yet taken Place, where the Uſe of it hath not yet been introduc'd, Arts and Sciences are not cultivated, nor any of thoſe Exerciſes ply'd, which polite Men's Spirits, and which abate the Uneaſineſs of Life. Men there are brutiſh and ſavage, none mind any Thing but Eating and Drinking, and the other Acts of brutal Nature; their Thoughts aſpire no higher than merely to maintain their Life and Breath: Like the Beaſts they walk abroad all the Day long, and range about from Place to Place, only to ſeek their Food. Whatever may be ſuppos'd to follow if all were acted with great Generoſity and true Charity, yet, according to the preſent Temper of Mankind, it is abſolutely neceſſary that there be ſome Method and Means of Commutation, as that of Money, for rendering all and every one mutually uſeful and ſerviceable.

Now Gold and Silver by their Rarity are wonderfully fitted and accommodated for this Uſe of Permutation for all Sorts of Commodities, or making Money of: Whereas were they

as common and eaſy to come by as Straw or Stubble, Sand or Stones, they would be of no more Uſe for Bartering and Commerce than they.

And here he goes on to ſhew the wonderful Providence of God, in keeping up the Value of Gold and Silver, notwithſtanding the vaſt Quantities which have been digg'd out of the Earth in all Ages, and ſo continuing them a fit Material to make Money of. For which I refer to the Book.

Of theſe, Gold is remarkable for its admirable Ductility and Ponderoſity, wherein it excels all other Bodies hitherto known. I ſhall only add, concerning Metals, that they do pertinaciouſly reſiſt all Tranſmutation; and tho' one would ſometimes think they were turn'd into a different Subſtance, yet do they but as it were lurk under a *Larva* or Vizard, and may be reduc'd again into their natural Form and Complexions, in Deſpite of all the Tortures of *Vulcan* or corroſive Waters. Note, *That this was written above Thirty Years ſince, when I thought I had Reaſon to diſtruſt whatever had then been reported or written to affirm the Tranſmutation of Metals one into another.*

I ſhall omit the Conſideration of other Minerals, and of Salts and Earths, becauſe I have nothing to ſay of their Uſes, but only ſuch as refer to Man, which I cannot affirm to have been the ſole or primary End of the Formation of them. Indeed, to ſpeak in general of theſe Terreſtrial Inanimate Bodies, they having no ſuch Organization of Parts as the Bodies of Ani-

mals, nor any so intricate Variety of Texture, but that their Production may plausibly be accounted for by an *Hypothesis* of Matter divided into minute Particles or Atoms naturally indivisible, of various but a determinate Number of Figures, and perhaps also differing in Magnitude, and these mov'd, and continually kept in Motion according to certain establish'd Laws or Rules; we cannot so clearly discover the Uses for which they were created, but may probably conclude, that among other Ends they were made for those for which they serve us and other Animals; as I shall more fully make out hereafter. It is here to be noted, That, according to our *Hypothesis*, the Number of the Atoms of each several Kind that is of the same Figure and Magnitude is not nearly equal, but there be infinitely more of some *Species* than of others, as of those that compound those vast Aggregates of *Air*, *Water*, and *Earth*, more abundantly than of such as make up *Metals* and *Minerals*: The Reason whereof may probably be, because those are necessary to the Life and Being of Man and all other Animals, and therefore must be always at Hand; these only useful to Man, and serving rather his Conveniences than Necessities. The Reason why I affirm the minute component Particles of Bodies to be naturally indivisible by any Agent we can employ, (even Fire it self) which is the only Catholick Dissolvent, other *Menstruums* being rather Instruments than Efficients in all Solutions, apt by Reason of the Figure and Smallness of their

Parts to cut and divide other Bodies (as Wedges cleave Wood) when actuated by Fire or its Heat, which else would have no Efficacy at all (as Wedges have not, unless driven by a Beetle:) The Reason, I say, I have already given; I shall now instance in a Body whose minute Parts appear to be indissoluble by the Force of Fire, and that is common Water, which distil, boil, circulate, work upon how you will by Fire, you can only dissolve it into Vapour, which when the Motion ceases, easily returns into Water again; Vapour being nothing else but the minute Parts thereof, by Heat agitated and separated one from another. For another instance, some of the most learn'd and experienc'd Chymists do affirm Quicksilver to be intransmutable, and therefore call it *Liquor æternus.* And I am of Opinion, that the same holds of all simple Bodies, that their component Particles are indissoluble by any natural Agent.

We may here note the Order and Method that Metals and Minerals observe in their Growth, how regularly they shoot, ferment, and as it were vegetate and regenerate; Salts in their proper and constant Figures, as our ingenious Countryman Dr. *Jordan* observes at large in his Discourse of Baths and Mineral Waters.

Of Vegetables or Plants.

I have now done with inanimate Bodies both simple and mix'd. The Animate are,

First,

First, Such as are endued only with a Vegetative Soul, and therefore commonly called *Vegetables* or *Plants*; of which, if we consider either their Stature and Shape, or their Age and Duration, we shall find it wonderful; for why should some Plants rise up to a great Height, others creep upon the Ground, which perhaps may have equal *Seeds?* nay, the lesser Plant many times the greater Seed. Why should each Particular so observe its Kind, as constantly to produce the same Leaf for Consistency, Figure, Division and Edging, and bring forth the same Kind of Flower, and Fruit, and Seed? and that tho' you translate it into a Soil which naturally puts forth no such Kind of Plant, so that it is some * Λόγος σπερματικὸς, which doth effect this, or rather some intelligent *plastick Nature*; as we have before intimated: For what Account can be given of the Determination of the Growth and Magnitude of Plants from Mechanical Principles, of *Matter mov'd* without the Presidency and Guidance of some superior Agent? Why may not Trees grow up as high as the Clouds or Vapours ascend? Or if you say the Cold of the superior Air checks them, Why may they not spread and extend their lateral Branches so far till their Distance from the Centre of Gravity depress them to the Earth, be the Tree never so high? How comes it to pass that tho' by Culture and Manure they may be highly improv'd, and augmented to a double, treble, nay, some a much greater Proportion in Magnitude of all their Parts, yet is this Advance

* Seminal Form or Virtue.

vance reſtrain'd within certain Limits? There is *maximum quod ſic* which they cannot exceed. You can by no Culture or Art extend a *Fennel-Stalk* to the Stature and Bigneſs of an *Oak:* Then why ſhould ſome be very long-liv'd, others only Annual or Biennial? How can we imagine that any Laws of Motion can determine the *Situation* of the *Leaves*, to come forth by Pairs, or alternately, or circling the Stalk; the *Flowers* to grow ſingly, or in Company and Tufts, to come forth the Boſoms of the Leaves and Branches, or on the Tops of Branches and Stalks; the *Figure* of the Leaves, that they ſhould be divided into ſo many Jags or Eſcallops, and curiouſly indented round the Edges; as alſo of the Flower-leaves, their Number and Site, the Figure and Number of the *Stamina* and their *Apices*, the Figure of the *Stile* and Seed-Veſſel, and the Number of Cells into which it is divided? That all this be done, and all theſe Parts duly proportion'd one to another, there ſeems to be neceſſary ſome intelligent *plaſtick Nature*, which may underſtand and regulate the whole Oeconomy of the Plants: For this cannot be the Vegetative Soul, becauſe that is material and diviſible together with the Body; which appears, in that a Branch cut off of a Plant will take Root, and grow, and become a perfect Plant it ſelf, as we have already obſerv'd. I had almoſt forgotten the Complication of the Seed-leaves of ſome Plants in the Seed, which is ſo ſtrange, that one cannot believe it to be done by Matter, however mov'd by any Laws or Rules imaginable. Some of them being ſo

cloſe-

close-plaited, and straitly folded up and thrust together within the Membranes of the Seed, that it would puzzle a Man to imitate it, and yet none of the Folds sticking or growing together; so that they may easily be taken out of their Cases, and spread and extended even with one's Fingers.

Secondly, If we consider each particular Part of a Plant, we shall find it not without its End or Use; the *Root*, for its Stability and drawing Nourishment from the Earth; the *Fibres*, to contain and convey the Sap; besides which, there is a large Sort of Vessels to contain the proper and specifick Juice of the Plant, and others to carry Air for such a Kind of Respiration as it needeth; of which we have already spoken. The outer and inner Bark in Trees serve to defend the trunk and Boughs from the Excesses of Heat and Cold, and Drought, and to convey the Sap for the annual Augmentation of the Tree; for in Truth, every Tree may in some Sense be said to be an annual Plant, both Leaf, Flower and Fruit proceeding from the Coat that was superinduced over the Wood the last Year, which Coat also never beareth any more, but together with the old Wood serves as a Form or Block to sustain the succeeding annual Coat. The *Leaves* before the *Gemma* or Bud be explicated to embrace and defend the Flower and Fruit, which is even then perfectly form'd; afterwards to preserve the Branches, Flowers and Fruit from the Injuries of the Summer-Sun, which would

too much parch and dry them, if they lay open and expos'd to its Beams without any Shelter: The Leaves, I say, qualify and contemper the Heat, and serve also to hinder the too hasty Evaporation of the Moisture about the Root: But the principal Use of the Leaves (as we learn of Signior *Malphigii*, Monsieur *Perault*, and Monsieur *Mariotte*) is to concoct and prepare the Sap for the Nourishment of the Fruit, and the whole Plant, not only that which ascends from the Root, but what they take in from without, from the Dew, moist Air and Rain. This they prove, because many Trees, if despoil'd of their Leaves, will die; as it happens sometimes in *Mulberry-Trees*, when they are pluck'd off to feed *Silk-worms*. And because if in Summer-Time you denude a Vine-Branch of its Leaves, the Grapes will never come to Maturity: But tho' you expose the Grapes to the Sun-Beams, if you pluck not off the Leaves, they will ripen notwithstanding. That there is a Regress of the Sap in Plants from above downwards, and that this descendent Juice is that which principally nourisheth both Fruit and Plant, is clearly prov'd by the Experiments of Signior *Malphigii*, and those late ones of an Ingenious Country-Man of our own, * *Thomas Brotherton* Esquire, of which I shall mention only one, that is, If you cut off a Ring of Bark from the Trunk of any Tree, that Part of the Tree above the Barked Ring shall grow and increase in Bigness, but not that beneath.

* Philosop. Transact. Num. 187.

But

But whether there be ſuch a conſtant Circulation of the Sap in Plants as there is of the Blood in Animals, as they would from hence infer, there is ſome Reaſon to doubt. I might add hereto the pleaſant and delectable cooling and refreſhing Shade they afford in the Summer-Time; which was very much eſteem'd by the Inhabitants of hot Countries, who always took great Delight and Pleaſure to ſit in the open Air, under ſhady Trees. Hence that Expreſſion ſo often repeated in Scripture, of every Man's *ſitting under his own Vine, and under his own Fig-Tree*, where alſo they us'd to eat; as appears by *Abraham*'s entertaining the Angels under a Tree, and ſtanding by them when they did eat, *Gen.* xviii. 8. Moreover, the Leaves of Plants are very beautiful and ornamental. That there is great Pulchritude and Comelineſs of Proportion in the Leaves, Flowers and Fruits of Plants, is atteſted by the general Verdict of Mankind, as Dr. *Moore* and others well obſerve. The adorning and beautifying the Temples and Buildings in all Ages, is an evident and undeniable Teſtimony of this; for what is more ordinary with *Architects* than the taking in Leaves and Flowers and Fruitage for the garniſhing of their Work; as the *Roman* the Leaves of *Achanthus ſat.* and the *Jewiſh* of *Palm-Trees* and *Pomegranats?* And theſe more frequently than any of the five regular Solids, as being more comely and pleaſant to behold. If any Man ſhall object, that Comelineſs of Proportion

tion and Beauty is but a mere Conceit, and that all Things are alike handsome to some Men who have as good Eyes as others; and that this appears by the Variation of Fashions, which doth so alter Men's Fancies, and what e're-while seem'd very handsome and comely, when it is once worn out of fashion appears very absurd, uncouth and ridiculous. To this I answer, That Custom and Use doth much in those Things where little of Proportion and Symmetry shew themselves, or which are alike comely and beautiful, to dispararge the one, and commend the other: But there are Degrees of Things; for (that I may use * Dr. *More*'s Words) I dare appeal to any Man that is not sunk into so forlorn a Pitch of Degeneracy, that he is as stupid to these Things as the basest Beasts, whether, for Example, a rightly-cut *Tetraedrom*, *Cube* or *Icosaedrom* have no more Pulchritude in them than any rude broken Stone lying in the Field or High-ways; or, to name other solid Figures, which tho' they be not regular, properly so call'd, yet have a settled *Idea* and Nature, as a *Cone*, *Sphere* or *Cylinder*, whether the Sight of those do not more gratify the Minds of Men, and pretend to more Elegancy of Shape, than those rude Cuttings or Chippings of Free-stone that fall from the Mason's Hands, and serve for nothing but to fill up the Middle of the Wall, as fit to be hid from the Eyes of Men for their Uglineſs? And therefore it is observable, that if Nature shape any Thing but near to this *Geometrical*

* Antidote against Atheism, *l.* 2. *c.* 5.

metrical Accuracy, that we take Notice of it with much Content and Pleasure, and greedily gather and treasure it up. As if it be but exactly round, as those spherical Stones found in *Cuba*, and some also in our own Land; or have but its Sides parallel, as those rhomboideal *Selenites* found near *St. Ives* in *Huntingtonshire*, and many other Places in *England*. Whereas ordinary Stones of rude and uncertain Figures we pass by, and take no notice of at all. But tho' the Figures of these Bodies be pleasing and agreeable to our Minds, yet (as we have already observ'd) those of the Leaves, Flowers and Fruits of Trees, more. And it is remarkable, that in the Circumscription and Complication of many Leaves, Flowers, Fruits, and Seeds, Nature affects a regular Figure. Of a Pentagonal or Quincunial Disposition, Sir *Thomas Brown* of *Norwich* produces several Examples in his Discourse about the *Quincunx*. And doubtless Instances might be given in other regular Figures, were Men but observant.

The *Flowers* serve to cherish and defend the first and tender Rudiments of the Fruit; I might also add the masculine or prolifick Seed contain'd in the Chives or *Apices* of the *Stamina*. These, besides the Elegancy of their Figures, are many of them endued with splendid and lovely Colours, and likewise most grateful and fragrant Odours. Indeed such is the Beauty and Lustre of some Flowers, that our Saviour saith of the Lillies of the Fields (which some, not without Reason, suppose to have been *Tulips*) that *Solomon in all his Glory was not arrayed like one of these.*

* *Isag. ad rem Herbariam.*

these. And it is observ'd by * *Spigelius*, That the Art of the most skilful Painter cannot so mingle and temper his Colours, as exactly to imitate or counterfeit the native ones of the Flowers of *Vegetables.*

† Antidote against Atheism, *l.* 2. *c.* 2.

As for the *Seeds* of *Plants*, † Dr. *More* esteems it an evident Sign of Divine Providence, that every Kind hath its Seed: For it being no necessary Result of the Motion of the Matter, (as the whole Contrivance of the Plant indeed is not) and it being of so great Consequence that they have Seed for the Continuance and Propagation of their own Species, and also for the gratifying Man's Art, Industry and Necessities, (for much of Husbandry and Gardening lies in this) it cannot but be an Act of Counsel to furnish the several Kinds of Plants with their Seeds.

Now the *Seed* being so necessary for the Maintenance and Increase of the several *Species*, it is worthy the Observation, what Care is taken to secure and preserve it, being in some doubly and trebly defended. As for Instance, in the *Walnut*, *Almond*, and *Plumbs* of all Sorts; we have first a thick pulpy Covering, then a hard Shell, within which is the Seed enclos'd in a double Membrane. In the *Nutmeg* another Tegument is added besides all these, *viz.* the *Mace* between the green *Pericarpium* and the hard Shell, immediately inclosing the Kernel. Neither yet doth the exterior Pulp of the Fruit or *Pericarpium* serve only for the Defence and Secu-

Security of the Seed whilſt it hangs upon the Plant, but after it is mature and fallen upon the Earth, for the Stercoration of the Soil and Promotion of the Growth, tho' not the firſt Germination of the ſeminal Plant. Hence (as * *Petrus de Creſcentiis* tells us) Huſbandmen, to make their Vines bear, manure them with Vine Leaves, or the Huſks of expreſſed Grapes; and they obſerve thoſe to be moſt fruitful which are ſo manur'd with their own; which Obſervation holds true alſo in all other Trees and Herbs. But beſides this Uſe of the Pulp or *Pericarpium* for the Guard and Benefit of the Seed, it ſerves alſo by a ſecondary Intention of Nature in many Fruits for the Food and Suſtenance of Man and other Animals.

* Agric. *l.* 2. *c.* 6.

Another thing worthy the noting in *Seeds*, and argumentative of Providence and Deſign, is that papoſe Plumage growing upon the Tops of ſome of them, whereby they are capable of being waſted with the Wind, and by that means ſcattered and diſſeminated far and wide.

Furthermore, moſt *Seeds* having in them a ſeminal Plant perfectly form'd, as the Young is in the Womb of Animals, the elegant Complication thereof in ſome *Species* is a very pleaſant and admirable Spectacle; ſo that no Man that hath a Soul in him can imagine or believe it was ſo form'd and folded up without Wiſdom and Providence. But of this I have ſpoken already.

Lastly, the immense Smallness of some Seeds, not to be seen by the naked Eye, so that the Number of Seeds produc'd at once in some one Plant, as for Example, *Reedmace* [*Typha Palustris*] *Hartstongue*, and many Sorts of *Ferns*, may amount to a Million, is a convincing Argument of the infinite Understanding and Art of the Former of them.

And it is remarkable that such *Mosses* as grow upon Walls, the Roofs of Houses, and other high Places, have Seeds so excessively small, that when shaken out of their Vessels they appear like Vapour or Smoke, so that they may either ascend of themselves, or by an easy Impulse of the Wind be rais'd up to the Tops of Houses, Walls or Rocks; and we need not wonder how the Mosses got thither, or imagine they sprung up spontaneously there.

I might also take notice of many other Particulars concerning Vegetables, as, First, that because they are design'd for the Food of Animals, therefore Nature hath taken more extraordinary Care, and made more abundant Provision for their Propagation and Increase; so that they are multiplied and propagated not only by the Seed, but many also by the Root, producing Off-sets, or creeping under Ground; many by Strings or Wyres running above Ground, as *Strawberry*, and the like, some by Slips or Cuttings, and some by several of these ways. And for the Security of such *Species* as are produc'd only by Seed, it hath endu'd all Seed with a lasting Vitality, that so if by reason of excessive Cold

Cold or Drought, or any other Accident, it happen not to germinate the firſt Year, it will continue its Fœcundity, I do not ſay two or three, nor ſix or ſeven, but even twenty or thirty Years; and when the Impediment is remov'd, the Earth in fit Caſe, and the Seaſon proper, ſpring up, bear Fruit, and continue its Species. Hence it is that Plants are ſometimes loſt for a while in Places where they formerly abounded, and again after ſome Years appear new; loſt, either becauſe the Springs were not proper for their Germination, or becauſe the Land was fallow'd, or becauſe plenty of Weeds or other Herbs prevented their coming up, and the like, and *appearing* again when theſe Impediments are remov'd. Secondly, That ſome Sorts of Plants, as *Vines*, all Sorts of *Pulſe*, *Hops*, *Briony*, all pomiferous Herbs, *Pumpions*, *Melons*, *Gourds*, *Cucumbers*, and divers other *Species*, that are weak and unable to raiſe or ſupport themſelves, are either endu'd with a Faculty of twining about others that are near, or elſe furniſh'd with Claſpers and Tendrils, whereby, as it were with Hands, they catch hold of them, and ſo ramping upon Trees, Shrubs, Hedges or Poles, they mount up to a great height, and ſecure themſelves and their Fruit. Thirdly, that others are arm'd with Prickles and Thorns, to ſecure them from the browſing of Beaſts, as alſo to ſhelter others that grow under them; moreover, they are hereby render'd very uſeful to Man, as if deſign'd by Nature to make both quick and dead Hedges and Fences. The great

great Naturaliſt *Pliny* hath given an ingenious Account of the Providence and Deſign of Nature in thus arming and fencing them in theſe Words: *Inde* (ſpeaking of Nature) *excogitavit aliquas aſpectu hiſpidas, tactu truces, ut tantùm non vocem ipſius Naturæ fingentis illas, rationemque reddentis exaudire videamur, ne ſe depaſcat avida quadrupes, ne procaces manus rapiant, ne neglecta veſtigia obterant, ne inſidens ales infringat; his muniendo aculeis teliſque armando, remediis ut ſalva ac tuta ſint. Ità hoc quoque quod in iis odimus hominum causâ excogitatum eſt.*

It is worthy the noting, that *Wheat*, which is the beſt Sort of Grain, of which the pureſt, moſt ſavoury and wholſome Bread is made, is patient of both Extremes, Heat and Cold, growing and bringing its Seed to Maturity not only in temperate Countries, but alſo on one hand in the cold and northern, *viz. Scotland*, *Denmark*, &c. on the other, in the hotteſt and moſt ſoutherly, as *Egypt*, *Barbary*, *Mauritania*, the *Eaſt-Indies*, *Guiney*, *Madagaſcar*, &c. ſcarce refuſing any Climate.

Nor is it leſs obſervable, and not to be commemorated without Acknowledgment of the divine Benignity to us, that (as *Pliny* rightly notes) nothing is more fruitful than *Wheat*, *Quod ei natura* (ſaith he) [*rectiùs naturæ Parens*] *tribuit, quòd eo maximè hominem alit, utpote cùm è modio, ſi & aptum ſolum, quale in Byzacio Africæ campo centeni quinquagìnta modii reddentur. Miſit ex eo loco Divo Auguſto procurator*

rator ejus ex uno grano (vix credibile dictu) 400 *paucis minus germina: Misit & Neroni similiter* 360 *stipulas ex uno grano.* "Which Fertility "Nature, (he shou'd have said, the Author of "Nature) hath conferr'd upon it, because it "feeds Man chiefly with it. One Bushel, if "sown in a fit and proper Soil, such as is *Byza-* "*cium*, a Field of *Africa*, yielding 150 of an- "nual Increase. *Augustus*'s *Procurator* sent him "from that Place 400 within a few Blades "springing from the same Grain: And to *Ne-* "*ro* were sent thence 360." If *Pliny*, a Heathen, could make this Fertility of Wheat argumentative of the Bounty of God to Man, making such plentiful Provision for him of that which is of most pleasant Taste and wholesome Nourishment, surely it ought not to be passed over by us *Christians* without Notice taking and Thanksgiving.

As for the Signatures of Plants, or the Notes impressed upon them, as *Indices* of their Virtues, though * some lay great Stress upon them, accounting them strong Arguments to prove, that some understanding Principle is the highest Original of the Works of Nature, as indeed they were, could it certainly be made appear, that there were such Marks designedly set upon them; because all that I find mention'd and collected by Authors, seem to me to be rather fancied by Men, than design'd by Nature to signify or point out any such Virtues or Qualities as they would make us believe. I have elsewhere, I think

* Dr. *More* Antid. l. 2. c. 6.

upon good Grounds, rejected them: and finding no Reason, as yet, to alter my Opinion, I shall not further insist on them: Howbeit, I will not deny, but that the noxious and malignant Plants do many of them discover something of their Nature by the sad and melancholick Visage of their Leaves, Flowers and Fruit. And that I may not leave that Head wholly untouch'd, one Observation I shall add relating to the Virtues of Plants, in which I think there is something of Truth; that is, that there are, by the wise Disposition of Providence, such *Species* of Plants produc'd in every Country, as are most proper and convenient for the Meat and Medicine of the Men and Animals that are bred and inhabit there: Insomuch that *Solenander* writes, that from the Frequency of the Plants that sprung up naturally in any Region, he could easily gather what Endemial Diseases the Inhabitants thereof were subject to: So in *Denmark*, *Friezland*, and *Holland*, where the Scurvy usually reigns, the proper Remedy thereof, *Scurvy-Grass*, doth plentifully grow.

Of Bodies enduced with a sensitive Soul, or Animals.

I proceed now to the Consideration of Animate Bodies endu'd with a sensitive Soul, call'd *Animals*. Of these I shall only make some general Observations, not curiously consider the Parts of each particular *Species*, save only as they serve for Instances or Examples.

First of all, because it is the great Design of Providence to maintain and continue every Species, I shall take Notice of the great Care and abundant Provision that is made for the securing this End. *Quanta ad eam rem vis, ut in suo quæque genere permaneat? Cic.* Why can we imagine all Creatures should be made Male and Female but to this Purpose? Why should there be implanted in each Sex such a vehement and inexpugnable Appetite of Copulation? Why in viviparous Animals, in the Time of Gestation, should the Nourishment be carried to the *Embryon* in the Womb, which at other Times goeth not that Way? When the Young is brought forth, how comes all the Nourishment then to be transferr'd from the Womb to the Breast or Paps, leaving its former Chanel, the Dam at such Time being for the most Part lean and ill-favour'd? To all this I might add, as a great Proof and Instance of the Care that is taken, and Provision made for the Preservation and Continuance of the Species, the lasting Fœcundity of the Animal Seed or Egg in the Females of Man, Beasts and Birds. I say, the Animal Seed, because it is to me highly probable, that the Females, as well of Beasts as Birds, have in them from their first Formation the Seeds of all the Young they will afterwards bring forth, which when they are all spent and exhausted by what Means soever, the Animal becomes barren and effete. These Seeds in some Species of Animals continue Fruitful, and apt to take Life by the Admixture of the Male-seed fifty Years or more, and in some

Birds fourſcore or an hundred. Here I cannot omit one very remarkable Obſervation I find in *Cicero: Atque ut intelligamus* (ſaith he) *nihil horum eſſe fortuitum, ſed hæc omnia providæ ſolertiſque naturæ, quæ multiplices fœtus procreant, ut ſues, ut canes, his mammarum data eſt multitudo, quas eaſdem paucas habent eæ beſtiæ quæ pauca gignunt. That we may underſtand that none of theſe Things* (he had been ſpeaking of) *is fortuitous, but that all are the Effects of provident and ſagacious Nature; multiparous Quadrupeds, as Swine, and Dogs, are furniſhed with a Multitude of Paps: Whereas thoſe Beaſts which bring forth few, have but a few.*

That flying Creatures of the greater Sort, that is, *Birds*, ſhould all lay Eggs, and none bring forth live Young, is a manifeſt Argument of Divine Providence, deſigning thereby their Preſervation and Security, that there might be the more Plenty of them; and that neither the Birds of Prey, the Serpent, nor the Fowler, ſhould ſtraiten their Generation too much: For if they had been viviparous, the Burden of their Womb, if they had brought forth any competent Number at a time, had been ſo great and heavy, that their Wings would have fail'd them, and they become an eaſy Prey to their Enemies: Or, if they had brought but one or two at a time, they would have been troubled all the Year long with feeding their Young, or bearing them in their Womb. *Dr.* More *Antid. Atheiſm, l.* 2. *c.* 9.

This

This Mention of feeding their Young puts me in mind of two or three conſiderable Obſervations referring thereto.

Firſt, ſeeing it would be for many Reaſons inconvenient for Birds to give ſuck, and yet no leſs inconvenient, if not deſtructive, to the Chicken upon Excluſion, all of a ſudden, to make ſo great a Change in its Diet, as to paſs from liquid to hard Food, before the Stomach be gradually conſolidated, and by Uſe ſtrengthen'd and habituated to grind and concoct it, and its tender and pappy Fleſh fitted to be nouriſh'd by ſuch ſtrong and ſolid Diet, and before the Bird be by little and little accuſtom'd to uſe its Bill, and gather it up, which at firſt it doth but very ſlowly and imperfectly; therefore Nature hath provided a large Yolk in every Egg, a great Part whereof remaineth after the Chicken is hatch'd, and is taken up and enclos'd in its Belly, and by a Chanel made on purpoſe, receiv'd by degrees into the Guts, and ſerves inſtead of Milk to nouriſh the Chick for a conſiderable time; which nevertheleſs mean while feeds it ſelf by the Mouth a little at a time, and gradually more and more, as it gets a perfecter Ability and Habit of gathering up its Meat, and its Stomach is ſtrengthen'd to macerate and concoct it, and its Fleſh harden'd and fitted to be nouriſh'd by it.

Secondly, That Birds which feed their Young in the Neſt, tho' in all likelihood they have no Ability of counting the Number of them, ſhould yet (tho' they bring but one Morſel of Meat at a time, and have not fewer (it may be)

than ſeven or eight Young in the Neſt together, which at the Return of their Dams, do all at once with equal Greedineſs, hold up their Heads and gape) not omit or forget one of them, but feed them all; which, unleſs they did carefully obſerve and retain in Memory which they had fed, which not, were impoſſible to be done: This, I ſay, ſeems to me moſt ſtrange and admirable, and beyond the Poſſibility of a mere Machine to perform.

Another Experiment I ſhall add, to prove, that tho' Birds have not an exact Power of numbring, yet have they of diſtinguiſhing many from few, and knowing when they come near to a certain Number: And that is, that when they have laid ſuch a Number of *Eggs*, as they can conveniently cover and hatch, they give over and begin to ſit; not becauſe they are neceſſarily determined to ſuch a Number; for that they are not, as is clear, becauſe they are in Ability to go on and lay more at their Pleaſure. Hens, for Example, if you let their *Eggs* alone, when they have laid fourteen or fifteen, will give over and begin to ſit; whereas, if you daily withdraw their *Eggs*, they will go on to lay five Times that Number: [Yet ſome of them are ſo cunning, that if you leave them but one *Egg*, they will not lay to it, but forſake their Neſt.] This holds not only in domeſtick and manſuete Birds, for then it might be thought the Effect of Cicuration or Inſtitution, but alſo in the wild; for my honour'd Friend Dr. *Martin Liſter* inform'd me, that

that of his own Knowledge one and the same *Swallow*, by the substracting daily of her *Eggs* proceeded to lay nineteen successively, and then gave over; as I have * elsewhere noted. Now that I am upon this Subject of the Number of *Eggs*, give me leave to add a remarkable Observation referring thereto, *viz.* That Birds, and such oviparous Creatures, as are long-liv'd, have *Eggs* enough at first conceiv'd in them to serve them for many Years laying, probably for as many as they are to live, allowing such a Proportion for every Year, as will serve for one or two Incubations; whereas Insects, which are to breed but once, lay all their *Eggs* at once, have they never so many. Now, had these Things been govern'd by Chance, I see no Reason why it should constantly fall out so.

* Preface to Mr. *Willoughby*'s Ornithol.

Thirdly, The marvellous speedy Growth of Birds that are hatch'd in Nests, and fed by the Old ones there, 'till they are fledg'd, and come almost to their full Bigness, at which Perfection they arrive within the short Term of about one Fortnight, seems to me an Argument of Providence, designing thereby their Preservation, that they might not lie long in a Condition expos'd to the Ravine of any Vermine that may find them, being utterly unable to escape or shift for themselves.

Another and no less effectual Argument may be taken from the Care and Providence us'd for the Hatching and Rearing their Young: And first, they search out a secret and quiet Place

where they may be ſecure and undiſturb'd in their Incubation; then they make themſelves Neſts every one after his Kind, that ſo their *Eggs* and *Young* may lie ſoft and warm, and their Excluſion and Growth be promoted. Theſe Neſts are ſome of them ſo elegant and artificial, that it is hard for Man to imitate them and make the like. I have ſeen Neſts of an *Indian* Bird ſo artificially compos'd of the Fibres, I think, of ſome Roots, ſo curiouſly interwoven and platted together, as is admirable to behold: Which Neſts they hang on the Ends of the Twigs of Trees over the Water, to ſecure their *Eggs* and *Young* from the Ravage of *Apes* and *Monkeys*, and other Beaſts, that might elſe prey upon them. After they have laid their *Eggs*, how diligently and patiently do they ſit upon them 'till they be hatch'd, ſcarce affording themſelves time to go off to get them Meat? Nay, with ſuch an ardent and impetuous Deſire of ſitting are they inſpired, that if you take away all their *Eggs*, they will ſit upon an empty Neſt: And yet one would think that ſitting were none of the moſt pleaſant Works. After their Young are hatch'd, for ſome time they do almoſt conſtantly brood them under their Wings, leſt the Cold and ſometimes perhaps the Heat ſhould harm them. All this while alſo they labour hard to get them Food, ſparing it out of their own Bellies, and pining themſelves almoſt to Death rather than they ſhould want. Moreover, it is admirable to obſerve with what Courage they are at that time inſpir'd, that they will even venture their own Lives

Lives in Defence of them. The moſt timorous, as *Hens* and *Geeſe*, become then ſo couragious, as to dare to fly in the Face of a Man that ſhall moleſt or diſquiet their Young, which would never do ſo much in their own Defence. Theſe things being contrary to any Motions of Senſe, or Inſtinct of Self-preſervation, and ſo eminent pieces of Self-denial, muſt needs be the Works of Providence, for the Continuation of the Species, and upholding of the World: Eſpecially if we conſider that all theſe Pains is beſtow'd upon a Thing which takes no Notice of it, will render them no Thanks for it, nor make them any Requital, or Amends; as alſo, that after the *Young* is come to ſome Growth, and able to ſhift for it ſelf, the old One retains no ſuch στοργὴ to it, takes no further Care of it, but will fall upon it, and beat it indifferently with others. To theſe I ſhall add three Obſervations more relating to this Head. The firſt borrow'd of Dr. *Cudworth*, Syſtem, *pag.* 69. One thing neceſſary to the Conſervation of the *Species* of Animals, that is, the keeping up conſtantly in the World a due numerical Proportion between the Sexes of *Male* and *Female*, doth neceſſarily infer a ſuperintending Providence. For did this depend only upon Mechaniſm, it cannot well be conceiv'd, but that in ſome Ages or other there ſhou'd happen to be all *Males*, or all *Females*, and ſo the Species fail. Nay, it cannot well be thought otherwiſe, but that there is in this a Providence, ſuperior to that of the *Plaſtick*

ſtick or *Spermatick Nature*, which hath not ſo much of Knowledge and Diſcretion allow'd to it, as whereby to be able to govern this Affair.

The Second of Mr. *Boyle* in his Treatiſe of the *high Veneration Man's Intellect owes to God*, p. 32. that is, the Conveniency of the Seaſon (or Time of Year) of the Production of Animals, when there is proper Food and Entertainment ready for them. *So we ſee, that, according to the uſual Courſe of Nature, Lambs, Kids, and many other living Creatures, are brought into the World at the Spring of the Year; when tender Graſs, and other Nutritive Plants, are provided for their Food. And the like may be obſerv'd in the Production of Silk-worms*, (yea, all other Eruca's, and many Inſects more) *whoſe Eggs, according to Nature's Inſtitution, are hatch'd when Mulberry-Trees begin to bud, and put forth thoſe Leaves, whereon thoſe precious Inſects are to feed; the Aliments being tender, whilſt the Worms themſelves are ſo, and growing more ſtrong and ſubſtantial, as the Inſects increaſe in Vigor and Bulk.* To theſe I ſhall add another Inſtance, that is, of the *Waſp*, whoſe Breeding is deferr'd till after the Summer-Solſtice, few of them appearing before *July*: Whereas one would be apt to think the vigorous and quickning Heat of the Sun in the Youth of the Year ſhould provoke them to generate much ſooner: [Provoke them, I ſay, becauſe every Waſp's-Neſt is begun by one great Mother-Waſp, which over-lives the Winter, lying

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ing hid in some hollow Tree or other *Latibulum*;] because then, and not till then, Pears, Plumbs, and other Fruit, design'd principally for their Food, begin to ripen.

The Third is mine own, That all Insects which do not themselves feed their Young, nor treasure up Provision in Store for their Sustenance, lay their *Eggs* in such Places as are most convenient for their Exclusion, and where, when hatch'd, their proper Food is ready for them: So, for Example, we see two Sorts of white *Butterflies* fastening their *Eggs* to Cabbage-Leaves, because they are fit Aliment for the *Catterpillers* that come of them; whereas should they affix them to the Leaves of a Plant improper for their Food, such Catterpillers must needs be lost, they chusing rather to die than to taste of such Plants; for that Kind of Insect (I mean Catterpillers) hath a nice and delicate Palate, some of them feeding only upon one particular *Species* of Plant, others on divers indeed, but those of the same Nature and Quality; utterly refusing them of a contrary. Like Instances might be produc'd in the other Tribes of Insects; it being perpetual in all, if not hinder'd or impriſon'd, electively to lay their *Eggs* in Places where they are seldom lost or miscarry, and where they have a Supply of Nourishment for their Young so soon as they are hatch'd, and need it: Whereas should they scatter them carelesly and indifferently in any Place, the greatest Part of the Young would in all likelihood perish soon

ſoon after their Excluſion for want of Food, and ſo their Numbers continually decreaſing, the whole Species in a few Years would be in Danger to be loſt: Whereas no ſuch thing, I dare ſay, hath happened ſince the firſt Creation.

It is here very remarkable, that thoſe Inſects, for whoſe Young Nature hath not made Proviſion of ſufficient Suſtenance, do themſelves gather and lay up in ſtore for them. So for Example: The *Bee*, the proper Food of whoſe * *Eulæ* is Honey, or perchance *Erithace*, (which we engliſh *Bee-Bread*) neither of which Viands being any where to be found amaſs'd by Nature in Quantity ſufficient for their Maintenance, doth herſelf with unwearied Diligence and Induſtry, flying from Flower to Flower, collect and treaſure them up.

* Bee-Maggot.

To theſe I ſhall now add an Obſervation of Mr. *Lewenhoeck*'s, concerning the ſudden Growth of ſome ſorts of Inſects, and the Reaſon of it.

It is (ſaith he) a wonderful Thing, and worthy the Obſervation, in Fleſh-Flies, that a Fly-Maggot, in five Days ſpace after it is hatch'd, arrives at its full Growth and perfect Magnitude. For if to the perfecting of it there were requir'd, ſuppoſe a Month's time or more, (as in ſome other Maggots is needful) it is impoſſible that about the Summer-Solſtice any ſuch Flies ſhou'd be produc'd, becauſe the Fly-Maggots have no Ability to ſearch out any other Food than that wherein they are placed by their Dams. Now this Food, ſuppoſe it be Fleſh, Fiſh,

or

or the Entrails of Beasts, lying in the Fields, expos'd to the hot Sun-beams, can last but a few Days in Case and Condition to be a fit Aliment for these Creatures, but will soon be quite parch'd and dry'd up, and therefore the most wise Creator hath given such a Nature and Temperament to them, that within a very few Days they attain to their just Growth and Magnitude; whereas on the contrary, other Maggots, who are in no such danger of being straiten'd for Food, continue a whole Month or more before they give over to eat and cease to grow. He proceeds further to tell us, that some of these *Fly-maggots* which he fed daily with fresh Meat, he brought to Perfection in four Days time; so that he conceives that in the Heat of Summer the *Eggs* of a *Fly*, or the *Maggots* contain'd in them, may in less than a Month's Space run through all their Changes, and come to perfect Flies, which may themselves lay *Eggs* again.

Secondly, I shall take notice of the various strange Instincts of Animals, which will necessarily demonstrate that they are directed to Ends unknown to them by a wise Superintendent: As, 1. That all Creatures should know how to defend themselves and offend their Enemies, where their natural Weapons are situate, and how to make use of them. A *Calf* will so manage his Head as tho' he would push with his Horns even before they shoot. A *Boar* knows the Use of his Tushes; a *Dog* of his Teeth; a *Horse* of his Hoofs; a *Cock* of his Spurs; a *Bee* of her Sting; a *Ram* will butt with his Head, yea tho' he be

brought

brought up tame, and never saw that manner of fighting. Now, why another Animal which hath no Horns should not make a shew of pushing, or no Spurs, of striking with his Legs, and the like, I know not, but that every Kind is providentially directed to the Use of its proper and natural Weapons. 2. That those Animals that are weak, and have neither Weapons nor Courage to fight, are for the most part created swift of Foot or Wing, and so being naturally timorous, are both willing and able to save themselves by Flight. 3. That Poultry, Partridge, and other Birds, should at the first sight know Birds of Prey, and make sign of it by a peculiar Note of their Voice to their Young, who presently thereupon hide themselves; that the *Lamb* should acknowledge the *Wolf* its Enemy, tho' it had never seen one before, as is taken for granted by most Naturalists, and may for ought I know be true, argues the Providence of Nature, or more truly the God of Nature, who for their Preservation hath put such an Instinct into them. 4. That young Animals as soon as they are brought forth should know their Food; as for Example, such as are nourish'd with Milk presently find their way to the Paps, and suck at them; whereas none of those that are not design'd for that Nourishment ever offer to suck, or seek out any such Food. Again, 5. That such Creatures as are whole-footed or Fin-toed, *viz.* some Birds, and Quadrupeds, are naturally directed to go into the Water, and swim there, as we see *Ducklings*, tho'

tho' hatch'd and led by a Hen, if ſhe brings them to the Brink of a River or Pond of Water, they preſently leave her, and in they go, though they never ſaw any ſuch thing done before, and tho' the Hen clucks and calls, and doth what ſhe can to keep them out. This *Pliny* takes notice of, *Hiſt. Nat. lib.* 10. *cap.* 55. in theſe Words, ſpeaking of Hens: *Super omnia eſt Anatum Ovis ſubditis atque excluſis admiratio, primo non planè agnoſcentis fœtum: mox incertos incubitus ſollicitè convocantis: Poſtremo lamenta circa piſcinæ ſtagna, mergentibus ſe pullis naturâ duce.* So that we ſee every Part in Animals is fitted to its Uſe, and the Knowledge of this Uſe put into them: For neither do any Sort of Web-footed Fowls live conſtantly upon the Land, or fear to enter the Water, nor any Land-Fowl ſo much as attempt to ſwim there. 6. Birds of the ſame Kind make their Neſts of the ſame Material, laid in the ſame Order, and exactly of the ſame Figure; ſo that by the ſight of the Neſt one may certainly know what Bird it belongs to; and this they do tho' living in diſtant Countries, and though they never ſaw nor could ſee any Neſt made, that is, though taken out of the Neſt and brought up by Hand; neither were any of the ſame Kind ever obſerv'd to make a different Neſt, either for Matter or Faſhion: This, together with the curious and artificial Contexture of ſuch Neſts, and their Fitneſs and Convenience for the Reception, hatching and cheriſhing the *Eggs* and *Young* of their reſpective Builders (which we have before taken

taken notice of) is a great Argument of a ſuperior Author of their and other Natures, who hath endu'd them with theſe Inſtincts, whereby they are as it were acted and driven to bring about Ends which themſelves aim not at (ſo far as we can diſcern) but are directed to; for (as *Ariſtotle* obſerves) οὔτε τέχνῃ, οὔτε ζητήσαντα, οὔτε βουλδυσάμενα ποιεῖ, *they act not by Art, neither do they enquire, neither do they deliberate about what they do.* And therefore, as Dr. *Cudworth* ſaith well, they are not Maſters of that Wiſdom according to which they act, but only paſſive to the Inſtincts and Impreſſes thereof upon them. And indeed to affirm that brute Animals do all theſe things by a Knowledge of their own, and which themſelves are Maſters of, and that without Deliberation and Conſultation, were to make them to be endu'd with a moſt perfect Intellect, far tranſcending that of human Reaſon; whereas it is plain enough that Brutes are not above Conſultation, but below it, and that theſe Inſtincts of Nature in them are nothing but a kind of Fate upon them.

The Migration of Birds from an hotter to a colder Country, or a colder to an hotter, according to the Seaſons of the Year, as their Nature is, I know not how to give an Account of, it is ſo ſtrange and admirable. What moves them to ſhift their Quarters? You will ſay, the Diſagreeableneſs of the Temper of the Air to the Conſtitution of their Bodies, or want of Food.

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But how come they to be directed to the ſame Place yearly, tho' ſometimes but a little Iſland, as the *Soland-Gooſe* to the *Baſſe* of *Edinburgh-Frith*, which they could not poſſibly ſee, and ſo it could have no Influence upon them that way? The Cold or the Heat might poſſibly drive them in a right Line from either; but that they ſhould impel Land-Birds to venture over a wide Ocean, of which they can ſee no End, is ſtrange and unaccountable; one would think that the Sight of ſo much Water, and preſent Fear of drowning, ſhould overcome the Senſe of Hunger, or Diſagreeableneſs of the Temper of the Air. Beſides, how come they to ſteer their Courſe aright to their ſeveral Quarters, which before the Compaſs was invented was hard for a Man himſelf to do, they being not able, as I noted before, to ſee them at that diſtance? Think we that the *Quails*, for inſtance, could ſee quite croſs the *Mediterranean-Sea?* and yet it is clear they fly out of *Italy* into *Africk*, lighting many times on Ships in the midſt of the Sea, to reſt themſelves when tir'd and ſpent with flying. That they ſhould thus ſhift Places, is very convenient for them, and accordingly we ſee they do it; which ſeems to be impoſſible they ſhould, unleſs themſelves were endu'd with Reaſon, or directed and acted by a ſuperior intelligent Cauſe.

The like may be ſaid of the Migration of divers Sorts of Fiſhes: As for Example; the *Salmon*, which from the Sea yearly aſcends up a River ſometimes 400 or 500 Miles, only to caſt

their Spawn, and ſecure it in Banks of Sand, for the Preſervation of it till the Young be hatch'd or excluded, and then return to Sea again. How theſe Creatures when they have been wandring a long time in the wide Ocean, ſhould again find out and repair to the Mouths of the ſame Rivers, ſeems to me very ſtrange, and hardly accountable, without recourſe to Inſtinct and the Direction of a ſuperior Cauſe. That Birds, ſeeing they have no Teeth for the Maſtication and Preparation of their Food, ſhould for the more convenient Comminution of it in their Stomachs or Gizzards, ſwallow down little Pebble-ſtones, or other hard Bodies; and becauſe all are not fit or proper for that Uſe, ſhould firſt try them in their Bills, to feel whether they be rough or angular, for their Turns, which if they find them not to be, they reject them; when theſe by the working of the Stomach are worn ſmooth, or too ſmall for their Uſe, they avoid them by Siege, and pick up others; that theſe are of great Uſe to them for the grinding of their Meat, there is no doubt: And I have obſerv'd in Birds that have been kept up in Houſes, where they could get no Pebbles, the very Yolks of their Eggs have chang'd Colour, and become a great deal paler than theirs who have their liberty to go abroad.

Beſides, I have obſerv'd in many Birds, the Gullet, before its entrance into the Gizzard, to be much dilated, and thick ſet, or as it were granulated, with a multitude of Glandules, each

whereof was provided with its excretory Veſſel, out of which, by an eaſy Preſſure, you might ſqueeze a Juice or Pap, which ſerved for the ſame Uſe which the *Saliva* doth in Quadrupeds, that is, for the macerating and diſſolution of the Meat into a Chyle; for that the *Saliva*, notwithſtanding its Inſipidneſs, hath a notable Virtue of macerating and diſſolving Bodies, appears by the Effects it hath in killing of Quickſilver, fermenting of Dough like Leaven or Yeaſt, taking away Warts, and curing other cutaneous Diſtempers; ſometimes exulcerating the Jaws, and rotting the Teeth.

Give me leave to add one Particular more concerning Birds, which ſome may perchance think too homely and indecent to be mentioned in ſuch a Diſcourſe as this; yet becauſe it is not below the Providence of Nature, and deſign'd for Cleanlineſs, and ſome great Men have thought it worth the obſerving, I need not to be aſham'd to take notice of it; that is, that in young Birds that are fed in the Neſt, the Excrement that is voided at one time is ſo viſcid, that it hangs together in a great Lump, as if it were incloſed in a Film, ſo that it may eaſily be taken up and carried away by the old Bird in her Bill; beſides, by a ſtrange Inſtinct the young Bird elevates her hinder Parts ſo high, for the moſt part, that ſhe ſeldom fails to caſt what comes from her clear over the ſide of the Neſt; ſo we ſee here is a double Proviſion made to keep the Neſt clean, which, if it were defiled with Ordure,

the young Ones must necessarily be utterly marr'd and ruin'd. 7. The *Bee*, a Creature of the lowest Forms of Animals, so that no Man can suspect it to have any considerable Measure of Understanding, or to have Knowledge of, much less to aim at any End, yet makes her Combs and Cells with that geometrical Accuracy, that she must needs be acted by an Instinct implanted in her by the wise Author of Nature; for first she plants them in a perpendicular Posture, and so close together as with Conveniency they may, beginning at the top and working downwards, that so no room may be lost in the Hive, and that she may have easy Access to all the Combs and Cells; besides, the Combs being wrought double, that is, with Cells on each side, a common Bottom or partition Wall could not in any other Site have so conveniently, if at all, receiv'd or contain'd the Honey; then she makes the particular Cells most geometrically and artificially, as the famous Mathematician *Pappus* demonstrates in the Preface to his third Book of *Mathematical Collections*. First of all (saith he, speaking of the Cells) it is convenient that they be of such Figures as may cohere one to another, and have common Sides, else there would be empty Spaces left between them to no Use, but to the weakening and spoiling of the Work, if any thing should get in there; and therefore, tho' a round Figure be most capacious for the Honey, and most convenient for the *Bee* to creep into, yet did she not make choice of that, be-

cauſe then there muſt have been triangular Spaces left void. Now there are only three rectilineous and ordinate Figures which can ſerve to this Purpoſe; and inordinate, or unlike ones, muſt have been not only leſs elegant and beautiful, but unequal. [Ordinate Figures are ſuch as have all their Sides and all their Angles equal.] The three ordinate Figures are, *Triangles*, *Squares*, and *Hexagons*; for the Space about any Point may be fill'd up either by ſix equilateral *Triangles*, or four *Squares*, or three *Hexagons*; whereas three *Pentagons* are too little, and three *Heptagons* too much. Of theſe three, the *Bee* makes uſe of the *Hexagon*, both becauſe it is more capacious than either of the other, provided they be of equal compaſs, and ſo equal Matter ſpent in the Conſtruction of each; and ſecondly, becauſe it is moſt commodious for the Bee to creep into; and laſtly, becauſe in the other Figures more Angles and Sides muſt have met together at the ſame Point, and ſo the Work could not have been ſo firm and ſtrong; moreover, the Combs being double, the Cells on each ſide the Partition are ſo order'd, that the Angles on one ſide inſiſt upon the Centers of the Bottoms of the Cells on the other ſide, and not Angle upon or againſt Angle, which alſo muſt needs contribute to the Strength and Firmneſs of the Work; theſe Cells ſhe fills with Honey for her Winter Proviſion, and curiouſly cloſes them up with Covers of Wax, that keep the included Liquor from ſpilling, and from external Injuries, as

Mr. *Boyle* truly obſerves, *Treatiſe of final Cauſes, p.* 169. Another Sort of *Bee* I have obſerv'd, may be called the *Tree-Bee*, whoſe Induſtry is admirable in making Proviſion for her Young. Firſt, ſhe digs round Vaults or Burrows [*Cuniculos*] in a rotten or decay'd Tree, of a great length, in them ſhe builds or forms her cylindrical Neſts or Caſes, reſembling Cartridges, or a very narrow Thimble, only in proportion longer, of pieces of Roſe, or other Leaves, which ſhe ſhears off with her Mouth, and plats and joins cloſe together by ſome glutinous Subſtance; theſe Caſes ſhe fills with a red Pap, of a thinner Conſiſtence than an Electuary, of no pleaſant Taſte, which where ſhe gathers I know not; and which is moſt remarkable, ſhe forms theſe Caſes and ſtores them with this Proviſion before ſhe hath any young One hatch'd, or ſo much as an Egg laid; for on the top of the Pap ſhe lays one Egg, and then cloſes up the Veſſel with a Cover of Leaves: the inclos'd Egg ſoon becomes an *Eula*, or Maggot, which feeding upon the Pap till it comes to its full Growth, changes to a *Nympha*, and after comes out a *Bee*. Another Inſect noted for her ſeeming Prudence, in making Proviſion for the Winter, propoſed by *Solomon* for our Imitation, is the *Ant*, which (as all Naturaliſts agree) hoard up Grains of Corn againſt the Winter for her Suſtenance, and is reported by ſome to * bite off the *Germen* of them, leſt they ſhould ſprout by the Moiſture of the Earth, which I look

* *Plin.* l. 11. c. 30.

look upon as a mere Fiction; neither ſhould I be forward to credit the former Relation, were it not for the Authority of the *Scripture*, becauſe I could never obſerve any ſuch ſtoring of Grain by our Country Ants.

Yet there is a Quadruped taken notice of even by the Vulgar, for laying up in ſtore Proviſion for the Winter; that is, the *Squirrel*, whoſe Hoards of Nuts are frequently found, and pillaged by them.

The *Beaver* is by credible Perſons, Eye-Witneſſes, affirm'd to build him Houſes for Shelter and Security in Winter-time. See Mr. *Boyle* of *final Cauſes*, *p.* 173.

Beſides theſe I have mention'd, an Hundred others may be found in Books relating eſpecially to Phyſick: as, that *Dogs* when they are ſick, ſhould vomit themſelves by eating Graſs; that *Swine* ſhould refuſe Meat ſo ſoon as they feel themſelves ill, and ſo recover by Abſtinence; that the Bird *Ibis* ſhould teach Men the way of adminiſtring Clyſters, *Plin. lib.* 8. *cap.* 27. the wild *Goats* of *Dictamus* for drawing out of Darts and healing Wounds; the *Swallow* the Uſe of *Celandine* for repairing the Sight, *&c. ibid.* Of the Truth of which, becauſe I am not fully ſatisfied, I ſhall make no Inference from them.

Thirdly, I ſhall remark the Care that is taken for the Preſervation of the Weak, and ſuch as are expos'd to the Injuries, and preventing the Increaſe of ſuch as are noiſome and hurtful; for

as it is a Demonſtration of the divine Power and Magnificence to create ſuch Variety of Animals, not only great but ſmall, not only ſtrong and courageous, but alſo weak and timorous; ſo is it no leſs Argument of his Wiſdom to give to theſe Means, and the Power and Skill of uſing them, to preſerve themſelves from the Violence and Injuries of thoſe. That of the Weak, ſome ſhould dig Vaults and Holes in the Earth, as *Rabbets*, to ſecure themſelves and their Young; others ſhould be arm'd with hard Shells; others with Prickles; the reſt that have no ſuch Armature, ſhould be endu'd with great Swiftneſs or Pernicity; and not only ſo, but ſome alſo have their Eyes ſtand ſo prominent, as the *Hare*, that they can ſee as well behind as before them, that ſo they may have their Enemy alway in their Eye; and long, hollow, moveable Ears, to receive and convey the leaſt Sound, or that which comes from far, that they be not ſuddenly ſurprized or taken (as they ſay) napping. Moreover, it is remarkable, that in this Animal, and in the *Rabbet*, the Muſcles of the Loins and hind Legs are extraordinarily large in proportion to the reſt of the Body, or thoſe of other Animals, as if made on purpoſe for Swiftneſs, that they may be able to eſcape the Teeth of ſo many Enemies as continually purſue and chaſe them; add hereto the Length of their hind Legs, which is no ſmall Advantage to them, as is noted by Dame *Julan Barns* in an ancient Dialogue in Verſe between the Huntſman and his Man: The Man

there

there asks his Maſter, What is the Reaſon, why the Hare when ſhe is near ſpent makes up a Hill? The Maſter anſwers, That Nature hath made the hinder-legs of the Hare longer than the Fore-legs; by which Means ſhe climbs the Hill with much more Eaſe than the Dogs, whoſe Legs are of equal Length, and ſo leaves the Dogs behind her, and many Times eſcapes away clear, and ſaves her Life. This laſt Obſervation, I muſt confeſs my ſelf to have borrowed out of the Papers of my honoured Friend Mr. *John Aubrey*, which he was pleaſed to give me a Sight of.

I might here add much concerning the Wiles and Ruſes, which theſe timid Creatures make uſe of to ſave themſelves, and eſcape their Perſecutors, but that I am ſomewhat diffident of the Truth of thoſe Stories and Relations. I ſhall only aver what my ſelf have ſometimes obſerv'd of a Duck, when cloſely purſued by a Water-Dog; ſhe not only dives to ſave herſelf, (which yet ſhe never does but when driven to an exigent, and juſt ready to be caught, becauſe it is painful and difficult to her) but when ſhe comes up again, brings not her whole Body above Water, but only her Bill, and Part of her Head, holding the reſt underneath, that ſo the Dog, who the mean time turns round and looks about him, may not eſpy her, 'till ſhe have recover'd Breath.

As for *Sheep*, which have no natural Weapons or Means to defend or ſecure themſelves, neither Heels to run, nor Claws to dig; they are deliver'd

deliver'd into the Hand, and committed to the Care and Tuition of Man; and ſerving him for divers Uſes, are nouriſhed and protected by him; and ſo enjoying their Beings for a Time, by this Means propagate and continue their Species: So that there are none deſtitute of ſome Means to preſerve themſelves, and their Kind; and theſe Means ſo effectual, that notwithſtanding all the Endeavours and Contrivances of Man and Beaſt to deſtroy them, there is not to this Day one *Species* loſt of ſuch as are mention'd in Hiſtories, and conſequently and undoubtedly neither of ſuch as were at firſt created.

Then for Birds of Prey, and rapacious Animals, it is remarkable what *Ariſtotle* obſerves, That they are all ſolitary, and go not in Flocks, Γαμψωνύχων οὐδὲν ἀγελαῖον, no Birds of Prey are gregarious. Again, that ſuch Creatures do not greatly multiply, τῶν γαμψωνύχων ὀλιγοτόκα πάντα. They for the moſt Part breeding and bringing forth but one or two, or at leaſt, a few Young Ones at once: Whereas they that are feeble and timorous are generally multiparous; or, if they bring forth but a few at once, as *Pigeons*, they compenſate that by their often breeding, *viz.* every Month but two throughout the Year; by this Means providing for the Continuation of their Kind. But for the Security of theſe rapacious Birds, it is worthy the noting, that becauſe a Prey is not always ready, but perhaps they may fail of one ſome Days, Nature hath made them patient of a long *inedia*, and beſides, when

when they light upon one, they gorge themſelves ſo therewith, as to ſuffice for their Nouriſhment for a conſiderable Time.

Fourthly, I ſhall note the exact Fitneſs of the Parts of the Bodies of Animals to every one's Nature and Manner of Living. A notable Inſtance of which we have in the *Swine*, a Creature well known, and therefore what I ſhall obſerve of it is obvious to every Man. His proper and natural Food being chiefly the Roots of Plants, he is provided with a long and ſtrong Snout; long, that he might thruſt it to a ſufficient Depth into the Ground without Offence to his Eyes; ſtrong and conveniently formed for the rooting and turning up the Ground. And beſides, he is endued with a notable Sagacity of Scent, for the finding out ſuch Roots as are fit for his Food. Hence in *Italy*, the uſual Method for finding and gathering of *Truffles*, or ſubterraneous Muſhromes, (called by the *Italians Tartufali*, and in *Latin Tubera terræ*) is, by tying a Cord to the Hind-leg of a Pig, and driving him before them into ſuch Paſtures as uſually produce that Kind of Muſhrome, and obſerving where he ſtops and begins to root, and there digging, they are ſure to find a *Truffle*; which when they have taken up, they drive away the Pig to ſearch for more. So I have my ſelf obſerved, that in Paſtures where there are *Earth-nuts* to be found up and down in ſeveral Patches, tho' the Roots lie deep in the Ground, and the Stalks be dead long before and quite gone,

gone, the Swine will by their Scent eaſily find them out, and root only in thoſe Places where they grow.

This rooting of the Hog in the Earth, calls to mind another Inſtance of like Nature, that is the *Porpeſſe*, which, as his *Engliſh* Name *Porpeſſe*, i. e. * *Porc peſce*, imports, reſembles the Hog, both in the Strength of his Snout, and alſo in the Manner of getting his Food by rooting; for we found the Stomach of one we diſſected full of *Sand-Eels*, or *Launces*, which for the moſt Part lie deep in the Sand, and cannot be gotten but by rooting or digging there. We have ſeen the Country-People in *Cornwall*, when the Tide was out, to fetch them out of the Sand with Iron-Hooks thruſt down under them, made for that Purpoſe.

* Swine-fiſh.

Furthermore, that very Action for which the Swine is abominated, and look'd upon as an unclean and impure Creature, namely wallowing in the Mire, is deſign'd by Nature for a very good End and Uſe, *viz.* not only to cool his Body, for the fair Water would have done that as well, nay, better, for commonly the Mud and Mire in Summer-time is warm; but alſo to ſuffocate and deſtroy Lice, Fleas, and other noiſom and importunate Inſects, that are troubleſome and noxious to him. For the ſame Reaſon do all the Poultry-kind, and divers other Birds, bask themſelves in the Duſt in Summer-time

time and hot Weather, as is obvious to every one to obſerve.

2. A ſecond and no leſs remarkable Inſtance, I ſhall produce, out of Dr. *More*'s *Antidote againſt Atheiſm*, lib. 2. cap. 10. in a poor and contemptible Quadruped, the *Mole*.

Firſt of all (ſaith he) her Dwelling being under Ground, where nothing is to be ſeen, Nature hath ſo obſcurely fitted her with Eyes, that Naturaliſts can ſcarcely agree, whether ſhe hath any Sight at all or no. [In our Obſervation, *Moles* have perfect Eyes, and Holes for them through the Skin, ſo that they are outwardly to be ſeen by any that ſhall diligently ſearch for them; tho' indeed they are exceeding ſmall, not much bigger than a great Pin's Head.] But for Amends, what ſhe is capable of for her Defence and Warning of Danger, ſhe has very eminently conferr'd upon her; for ſhe is very quick of hearing, [doubtleſs her ſubterraneous Vaults are lik Trunks to convey any Sound a great Way.] And then her ſhort Tail and ſhort Legs, but broad Fore-feet armed with ſharp Claws, we ſee by the Event to what purpoſe they are, ſhe ſo ſwiftly working herſelf under Ground, and making her Way ſo faſt in the Earth, as they that behold it cannot but admire it. Her Legs therefore are ſhort, that ſhe need dig no more than will ſerve the mere Thickneſs of her Body: And her fore-feet are broad, that ſhe may ſcoup away much Earth at a Time: And ſhe has little or no Tail, becauſe ſhe courſes it not on the Ground like a *Rat* or *Mouſe*, but lives under the Earth,

Earth, and is fain to dig herſelf a Dwelling there; and ſhe making her Way thro' ſo thick an Element, which will not eaſily yield as the Water and Air do, it had been dangerous to draw ſo long a Train behind her; for her Enemy might fall upon her Rear, and fetch her out before ſhe had perfected and got full Poſſeſſion of her Works: Which being ſo, what more palpable Argument of Providence than ſhe?

Another Inſtance in Quadrupeds might be the *Tamandua* or *Ant-Bear*, deſcrib'd by *Marcgrave* and *Piſo*, who ſaith of them, that they are Night-walkers, and ſeek their Food by Night. Being kept tame, they are fed with Fleſh, but it muſt be minced ſmall, becauſe they have not only a ſlender and ſharp Head and Snout, but alſo a narrow and toothleſs Mouth; their Tongue is like a great Lute-ſtring (as big as a Gooſe-quill) round, and in the greater Kind (for there are two *Species*) more than two Foot long, and therefore lies doubled in a Chanel between the lower Parts of the Cheeks. This when hungry they thruſt forth, being well moiſtned, and lay upon the Trunk of Trees, and when it is cover'd with *Ants*, ſuddenly draw it back into their Mouths; if the *Ants* lie ſo deep that they cannot come at them, they dig up the Earth with their long and ſtrong Claws, wherewith for that Purpoſe their Fore-feet are armed. So we ſee how their Parts are fitted for this Kind of Diet, and no other; for the catching of it, and for the eating of it, it requiring

quiring no Comminution by the Teeth, as appears also in the *Chamælion*, which is another Quadruped that imitates the *Tamandua* in this Property of darting out the Tongue to a great Length, with wonderful Celerity; and for the same Purpose too of catching of Insects.

Besides these Quadrupeds, there are a whole Genus of *Birds*, called *Pici Marcii*, or *Wood-Peckers*, that in like Manner have a Tongue which they can shoot forth to a very great Length, ending in a sharp stiff bony Rib, dented on each Side; and at pleasure thrust it deep into the Holes, Clefts, and Crannies of Trees, to stab and draw out *Cossi*, or any other Insects lurking there, as also into Ant-hills, to strike and fetch out the *Ants* and their *Eggs*. Moreover, they have short, but very strong Legs, and their Toes stand two forwards, two backwards, which Disposition (as *Aldrovandus* well notes) Nature, or rather the Wisdom of the Creator, hath granted to *Woodpeckers*, because it is very convenient for the climbing of Trees, to which also conduces the Stiffness of the Feathers of their Tails, and their bending downward, whereby they are fitted to serve as a Prop for them to lean upon, and bear up their Bodies. As for the *Chamælion*, he imitates the *Woodspite*, not only in the Make, Motion, and Use of his Tongue for striking *Ants*, *Flies*, and other Insects; but also in the Site of his Toes, whereby he is wonderfully qualified to run upon Trees, which he doth

does with that Swiftneſs, that one would think he flew, whereas upon the Ground he walks very clumſily and ridiculouſly. A full Deſcription of the outward and inward Parts of this Animal, may be ſeen at the End of *Penarolus*'s *Obſervat.* It is to be noted, that the *Chamælion*, tho' he hath Teeth, uſes them not for chewing his Prey, but ſwallows it immediately.

I ſhall add two Inſtances more in Birds, and thoſe are,

1. The *Swallow*, whoſe proper Food is ſmall Beetles, and other Inſects flying about in the Air; as we have found by diſſecting the Stomachs both of old Ones and Neſtlings: Which is wonderfully fitted for the catching of theſe Animalcules; for ſhe hath long Wings, and a forked Tail, and ſmall Feet, whereby ſhe is as it were made for ſwift Flight, and enabled to continue long upon the Wing, and to turn nimbly in the Air: And ſhe hath alſo an extraordinary wide Mouth, ſo that it's very hard for any Inſect, that comes in her Way to eſcape her. It is thought to be a Sign of Rain, when this Bird flies low near to the Ground; in which there may be ſome Truth; becauſe the Inſects which ſhe hunts may at ſuch Times, when the ſuperior Air is charged with Vapours, have a Senſe of it, and deſcend near the Earth. Hence, when there are no more Inſects in the Air, as in Winter-time, thoſe Birds do either abſcond, or betake themſelves into hot Countries.

2. The

2. The *Colymbi*, or *Douchers*, or *Loons*, whose Bodies are admirably fitted and conformed for diving under Water, being cover'd with a very thick Plumage, and the *Superficies* of their Feathers so smooth and slippery, that the Water cannot penetrate, or moisten them; whereby their Bodies are defended from the Cold, the Water being kept at a Distance, and so poised, that by a light Impulse they may easily ascend in it. Then their Feet are situate in the hindmost Part of their Body, whereby they are enabled, shooting their Feet backwards, and striking the Water upwards, to plunge themselves down into it with great Facility, and likewise to move forwards therein. Then their Legs are made flat and broad, and their Feet cloven into Toes with appendant Membranes on each Side, by which Configuration they easily cut the Water, and are drawn forward, and so take their Stroke backwards; and besides, I conceive, that by means of this Figure, their Feet being mov'd to the Right and Left-hand, serve them as a Rudder to enable them to turn under Water: For some conceive, that they swim easier under Water than they do above it. How they raise themselves up again, whether their Bodies emerge of themselves by their Lightness, or whether by striking against the Bottom, in Manner of a Leap, or by some peculiar Motion of their Legs, I cannot determine. That they dive to the Bottom is clear; for that in the Stomachs both of the greater and lesser Kinds we found Grass and other Weeds, and in the les-

ſer kind nothing elſe; though both prey upon Fiſh. Their Bills alſo are made ſtreight and ſharp for the eaſier cutting of the Water, and ſtriking their Prey. Could we ſee the Motions of their Legs and Feet in the Water, then we ſhould better comprehend how they aſcend, deſcend, and move to and fro; and diſcern, how wiſely and artificially their Members are formed and adapted to thoſe Uſes.

II. In *Birds*, all the Members are moſt exactly fitted for the Uſe of Flying. Firſt, The Muſcles, which ſerve to move the Wings, are the greateſt and ſtrongeſt, becauſe much Force is required to the Agitation of them; the underſide of them is alſo made Concave, and the upper Convex, that they may be eaſily lifted up, and more ſtrongly beat the Air, which by this Means doth more reſiſt the Deſcent of their Body downwards. Then the Trunk of their Body doth ſomewhat reſemble the Hull of a Ship; the Head, the Prow, which is for the moſt part ſmall, that it may the more eaſily cut the Air, and make way for their Bodies; the Train ſerves to ſteer, govern, and direct their Flight; and however it may be held erect in their ſtanding, or walking, yet is directed to lie almoſt in the ſame Plain with their Backs, or rather a little inclining when they fly. That the Train ſerves to ſteer and direct their Flight, and turn their Bodies like the Rudder of a Ship, is evident in the *Kite*, who, by a light turning of his Train, moves

moves his Body which way he pleaſes. *Iidem videntur artem gubernandi docuiſſe caudæ flexibus, in Cœlo monſtrante natura quod opus eſſet in profundo*, Plin. Lib. 10. c. 10. *They ſeem to have taught Men the Art of ſteering a Ship by the Flexures of their Tails; Nature ſhewing in the Air what was needful to be done in the Deep.* And it's notable that *Ariſtotle* truly obſerves, that whole-footed Birds, and thoſe that have long Legs, have for the moſt part ſhort Tails; and therefore whilſt they fly, do not, as others, draw them up to their Bellies, but ſtretch them at length backwards, that they may ſerve to ſteer and guide them inſtead of Tails. Neither doth the Tail ſerve only to direct and govern the Flight, but alſo partly to ſupport the Body, and keep it even; wherefore, when ſpread, it lies parallel to the Horizon, and ſtands not perpendicular to it, as Fiſhes do. Hence Birds that have no Tails, as ſome Sorts of *Colymbi*, or Duckers, fly very inconveniently with their Bodies almoſt erect.

To this I ſhall add further, That the Bodies of Birds are ſmall in Compariſon of Quadrupeds, that they may more eaſily be ſupported in the Air during their Flight; which is a great Argument of Wiſdom and Deſign: Elſe why ſhould not we ſee Species of *Pegaſi*, or Flying-Horſes, of *Griffins*, of *Harpies*, and an Hundred more, which might make a Shift to live well enough, notwithſtanding they could make no Uſe of their Wings: Beſides, their Bodies are not only ſmall, but of a broad Figure, that

the Air may more resist their Descents; they are also hollow and light; nay, their very Bones are light: For though those of the Legs and Wings are solid and firm, yet have they ample Cavities, by which Means they become more rigid and stiff; it being demonstrable, that a hollow Body is more stiff and inflexible than a solid one of equal Substance and Matter. Then the Feathers also are very light, yet their Shafts hard and stiff, as being either empty, or filled with a light and spungy Substance, and their Webs are not made of continued Membranes; for then, had a Rupture by any Accident been made in them, it could not have been consolidated, but of two Series of numerous *Pumulæ*, or contiguous Filaments, furnished all along with Hooks on each side, whereby catching hold on one another, they stick fast together; so that when they are ruffled, or discomposed, the Bird with her Bill can easily preen them, and reduce them to their due Position again. And for their firmer Cohæsion, the wise and bountiful Author of Nature hath provided and placed on the Rump two Glandules, having their excretory Vessels, round which grow Feathers in Form of a Pencil, to which the Bird turning her Head, catches hold upon them with her Bill, and a little compressing the Glandules, squeezes out and brings away therewith an oily Pap, or Liniment, most fit and proper for the Inunction of the Feathers, and causing their Filaments more strongly to cohere. And is not this strange and admirable,

ble, and argumentative of Providence, that there ſhould be ſuch an Unguent, or Pap, prepared, ſuch an open Veſſel to excern it into, to receive and retain it; that the Bird ſhould know where it is ſituate, and how, and to what Purpoſes to uſe it? And becauſe the Bird is to live many Years, and the Feathers in time would, and muſt neceſſarily be worn and ſhatter'd, Nature hath made Proviſion for the caſting and renewing of them Yearly. Moreover, thoſe large Bladders, or Membranes, extending to the Bottoms of the Bellies of Birds, into which the Breath is received, conduce much to the alleviating of the Body, and facilitating the Flight: For the Air received into theſe Bladders, is by the Heat of the Body extended into twice, or thrice, the Dimenſions of the External, and ſo muſt needs add a Lightneſs to the Body. And the Bird when ſhe would deſcend, may either compreſs this Air by the Muſcles of the *Abdomen*, or expire as much of it as may enable her to deſcend ſwifter, or ſlower, as ſhe pleaſes. I might add the Uſe of the Feathers in cheriſhing and keeping the Body warm; which, the Creature being of ſmall Bulk, muſt needs ſtand in great Stead againſt the Rigour of the Cold. And for this Reaſon we ſee, that Water-Fowls, which were to ſwim, and ſit long upon the cold Water, have their Feathers very thick ſet upon their Breaſts and Bellies, and beſides a plentiful Down there growing, to fence againſt the Cold of the Water, and to keep off its immediate Contact.

That the Tails of all Birds in general do not conduce to their turning to the Right and Left, according to the common Opinion, but rather for their Aſcent and Deſcent, ſome modern Philoſophers have obſerv'd and prov'd by Experiment; for that if you pluck off, for Inſtance, a Pigeon's Tail, ſhe will nevertheleſs, with equal Facility, turn to and fro: Which upon ſecond Thoughts, and further Conſideration, I grant to be true, in Birds whoſe Tails are pointed, and end in a right Line: But in thoſe that have forked Tails, Autopſy convinceth us that it hath this Uſe; and therefore they pronounce too boldly of all in general. For it is manifeſt to Sight, that the fork'd-tail Kite, by turning her Train ſideways, elevating one Horn, and depreſſing the other, turns her whole Body. And doubtleſs the Tail hath the ſame uſe in *Swallows*, who make the moſt ſudden Turns in the Air of any Birds, and have all of them forked Tails.

III. As for *Fiſhes*, their Bodies are long and ſlender, or elſe thin, for the moſt Part, for their more eaſy ſwimming, and dividing the Water. The Wind-bladder, wherewith moſt of them are furniſhed, ſerves to poiſe their Bodies, and keep them equiponderant to the Water, which elſe wou'd ſink to the Bottom, and lie groveling there, as hath, by breaking the Bladder, been experimentally found. By the Contraction and Dilatation of this Bladder, they are able to raiſe, or ſink themſelves at Pleaſure, and continue in what Depth of Water they liſt.

The Fins, made of griſtly Spokes, or Rays, connected by Membranes, ſo that they may be contracted, or extended like Womens Fans, and furniſhed with Muſcles for Motion, ſerve partly for Progreſſion, but chiefly to hold the Body upright; which appears in that when they are cut off, it wavers to and fro, and ſo ſoon as the Fiſh dies, the Belly turns upwards. The great Strength by which Fiſhes dart themſelves forward with incredible Celerity, like an Arrow out of a Bow, lies in their Tails, their Fins, mean time, leſt they ſhould retard their Motion, being held cloſe to their Bodies. And therefore almoſt the whole Muſculous Fleſh of the Body is beſtow'd upon the Tail and Back, and ſerves for the Vibration of the Tail, the Heavineſs and Corpulency of the Water requiring a great Force to divide it.

In *Cetaceous* Fiſhes, or, as the *Latins* call them, * Sea-Beaſts, the Tail hath a different Poſition from what it hath in all other Fiſhes; for whereas in theſe it is erected perpendicular to the Horizon, in them it lies parallel thereto, partly to ſupply the Uſe of the hinder Pair of Fins which theſe Creatures lack, and partly to raiſe and depreſs the Body at pleaſure. For it being neceſſary that theſe Fiſhes ſhould frequently aſcend to the Top of the Water to breathe, or take in and let out the Air, it was fitting and convenient that they ſhould be provided with an Organ to facilitate their Aſcent and Deſcent as they had Occaſion. And as for their turning of their Bodies in the Water, they

* Belluæ Marinæ.

muſt perform that as Birds do, by the Motion of one of their Fins, while the other is quieſcent. It is no leſs remarkable in them, that their whole Body is incompaſſed round with a copious Fat, which our Fiſhermen call the *Blubber*, of a great Thickneſs; which ſerves partly to poiſe their Bodies, and render them equiponderant to the Water; partly to keep off the Water at ſome Diſtance from the Blood, the immediate Contact whereof would be apt to chill it; and partly alſo for the ſame Uſe that Clothes ſerve us, to keep the Fiſh warm, by reflecting the hot Steams of the Body, and ſo redoubling the Heat, as we have before-noted. For we ſee, by Experience, that fat Bodies are nothing near ſo ſenſible of the Impreſſions of Cold as lean. And I have obſerved fat Hogs to have lain abroad in the open Air, upon the cold Ground, in Winter Nights; whereas the lean Ones have been glad to creep into their Cotes, and lie upon Heaps to keep themſelves warm.

I might here take Notice of thoſe Amphibious Creatures, which we may call Aquatic Quadrupeds (though one of them there is that hath but two Feet, *viz.* the *Manati*, or Sea-Cow) the *Beaver*, the *Otter*, the *Phoca*, or Sea-Calf, the *Water-Rat*, and the *Frog*, the Toes of whoſe Feet are joined by Membranes, as in Water-Fowls, for ſwimming; and who have very ſmall Ears, and Ear-holes, as the Cetaceous Fiſhes have, for hearing in the Water.

To this Head belongs the adapting of the Parts that miniſter to Generation in the Sexes

one to another; and in Creatures that nouriſh their Young with Milk, the Nipples of the Breaſt to the Mouth and Organs of Suction; which he muſt needs be wilfully blind and void of Senſe, that either diſcerns not, or denies to be intended and made one for the other. That the Nipples ſhould be made ſpungy, and with ſuch Perforations, as to admit Paſſage to the Milk when drawn, otherwiſe to retain it; and the Teeth of the Young either not ſprung, or ſo ſoft and tender, as not to hurt the Nipples of the Dam, are Effects and Arguments of Providence and Deſign.

A more full Deſcription of the Breaſts and Nipples I meet with, in a Book of that ingenious Anatomiſt and Phyſician, *Antonius Nuck*, entitled, *Adenographia Curioſa*, cap. 2. He makes the Breaſts to be nothing but Glandules of that Sort they call *Conglomeratæ*, made up of an infinite Number of little Knots, or Kernels, each whereof has its excretory Veſſel, or Lactiferous Duct; three, or four, or five of theſe preſently meet, and join into one ſmall Trunk, in like Manner do the adjacent Glandules meet and unite; ſeveral of theſe leſſer Trunks, or Branches, concurring, make up an excretory Veſſel of a notable Bigneſs, like to that of the *Pancreas*, but not ſo long, yet ſufficiently large, to receive and retain a good Quantity of Milk; which before it enters the Nipple, is again contracted, and ſtraitned to that Degree, that it will ſcarce admit a ſmall Briſtle. Who now can be ſo impudent as to deny, that all this was contrived and

deſigned

designed purposely to retain the Milk, that it should not flow out of it self, but easily be drawn out by Pressure and Suction; or to affirm that this fell out accidentally, than which there could not have been a more ingenious Contrivance for the Use to which it is employ'd, invented by the Wit of Man?

To this Head of the Fitness of the Parts of the Body to the Creature's Nature, and Manner of Living, belongs that Observation of *Aristotle*, τῶν ὀρνίθων ὅσα μὲν καμψώνυχα σαρκοφάγα πάντα. Such Birds as have crooked Beaks and Talons, are all Carnivorous; and so of Quadrupeds, καρχαρόδοντα, *Carnivora omnia*. All that have Serrate Teeth, are Carnivorous. This Observation holds true concerning all *European* Birds; but I know not but that *Parrots* may be an Exception to it. Yet it is remarkable, that such Birds as are Carnivorous have no Gizzard, or Musculous, but a Membranous Stomach, that Kind of Food needing no such Grinding, or Comminution as Seeds do, but being torn into Strings, or small Flakes, by the Beak, may be easily concocted by a Membranous Stomach.

To the Fitness of all the Parts and Members of Animals, to their respective Uses, may also be referred another Observation of the same *Aristotle*, Πάντα τὰ ζῶα ἀρτίους ἔχει πόδας. All Animals have even Feet, not more on one Side than another; which, if they had, would either hinder their walking, or hang by not only useless, but also burthensome. For though a Creature might make a limping Shift to hop, suppose

ſuppoſe with three Feet, yet nothing ſo conveniently or ſteddily to walk or run, or indeed to ſtand; ſo that we ſee Nature hath made choice of what is moſt fit, proper, and uſeful: They have alſo not only an even Number of Feet, anſwering by Pairs one to another, which is as well decent as convenient, but thoſe too of an equal Length, I mean, the ſeveral Pairs; whereas were thoſe on one ſide longer than they on the other, it would have caus'd an inconvenient halting or limping in their going.

I ſhall mention but one more Obſervation of *Ariſtotle*, that is, Πτηνὸν μόνον ἐδὲν, there is no Creature only volatile, or no flying Animal, but hath Feet as well as Wings, a Power of walking or creeping upon the Earth, becauſe there is no Food, or at leaſt not ſufficient Food for them to be had always in the Air; or if in hot Countries we may ſuppoſe there is, the Air being never without Store of Inſects flying about in it, yet could ſuch Birds take no Reſt, for having no Feet they could not pearch upon Trees; and if they ſhould alight upon the Ground, they could by no means raiſe themſelves any more, as we ſee thoſe Birds which have but ſhort Feet, as the *Swift* and *Martinet*, with difficulty do; beſides, they would want means of breeding, having no where to lay their Eggs, to ſit, hatch, or brood their Young. As for the Story of the *Manucodiata*, or *Bird of Paradiſe*, which in the former Ages was generally receiv'd and accepted for true, even by the Learned, it is now diſcover'd

to

to be a Fable, and rejected and exploded by all Men, those Birds being well known to have Legs and Feet as well as others, and those not short, small, nor feeble ones, but sufficiently great and strong, and arm'd with crooked Talons, as being the Members of Birds of Prey.

It is also very remarkable, that all flying Insects should be cover'd with shelly Scales, like Armour, partly to secure them from external Violence, from Injuries by Blows and Pressures; partly to defend their tender Muscles from the Heat of the Sun-beams, which would be apt to parch and dry them up, being of small Bulk; partly also to restrain the Spirits, and to prevent their Evaporation.

I shall now add another Instance of the Wisdom of Nature, or rather the God of Nature, in adapting the Parts of the same Animal one to another, and that is, the proportioning the Length of the Neck to that of the Legs. For seeing terrestrial Animals, as well Birds as Quadrupeds, are endu'd with Legs, upon which they stand, and wherewith they transfer themselves from Place to Place to gather their Food, and for other Conveniences of Life, and so the Trunk of their Body must needs be elevated above the Superficies of the Earth, so that they could not conveniently either gather their Food or Drink if they wanted a Neck, therefore Nature hath not only furnish'd them therewith, but with such an one as is commensurable to their Legs, except here the Elephant, which hath indeed a short Neck,

Neck, for the exceſſive Weight of his Head and Teeth, which to a long Neck would have been inſupportable, but is provided with a Trunk, wherewith, as with a Hand, he takes up his Food and Drink, and brings it to his Mouth. I ſay, the Necks of Birds and Quadrupeds are commenſurate to their Legs, ſo that they which have long Legs have long Necks, and they that have ſhort Legs, ſhort ones, as is ſeen in the *Crocodile*, and all *Lizards*; and thoſe that have no Legs, as they do not want Necks, ſo neither have they any, as *Fiſhes*. This Equality between the Length of the Legs and Neck, is eſpecially ſeen in Beaſts that feed conſtantly upon Graſs, whoſe Necks and Legs are always very near equal; very near, I ſay, becauſe the Neck muſt neceſſarily have ſome Advantage, in that it cannot hang perpendicularly down, but muſt incline a little; moreover, becauſe this Sort of Creatures muſt needs hold their Heads down in an inclining Poſture for a conſiderable time together, which would be very laborious and painful for the Muſcles, therefore on each ſide the Ridge of the Vertebres of the Neck Nature hath placed an Ἀπονεύρωσις, or nervous Ligament, of a great thickneſs and ſtrength, apt to ſtretch, and ſhrink again, as need requires, and void of Senſe, extending from the Head (to which, and the next Vertebres of the Neck, it is faſten'd at that end) to the middle Vertebres of the Back (to which it is knit at the other) to aſſiſt them to ſupport the Head in that Poſture; which *Aponeuroſis* is taken notice of by the

the Vulgar by the Name of *Fixfax*, or *Pack-wax*, or *White-leather*. It is alſo very obſervable in Fowls that wade in the Water, which having long Legs, have alſo Necks anſwerably long; only in theſe too there is an Exception, exceeding worthy to be noted; for ſome Water-Fowl, which are *Palmipeds*, or whole-footed, have very long Necks, and yet but ſhort Legs, as *Swans* and *Geeſe*, and ſome *Indian* Birds; wherein we may obſerve the admirable Providence of Nature. For ſuch Birds as were to ſearch and gather their Food, whether Herbs or Inſects, in the bottom of Pools and deep Waters, have long Necks for that purpoſe, though their Legs, as is moſt convenient for ſwimming, be but ſhort; whereas there are no Land-Fowl to be ſeen with ſhort Legs and long Necks, but all have their Necks in Length commenſurate to their Legs. This Inſtance is the more conſiderable, becauſe the Atheiſts uſual Flam will not here help them out; for (ſay they) there were many Animals of diſproportionate Parts and of abſurd and uncouth Shapes produc'd at firſt, in the Infancy of the World, but becauſe they could not gather their Food, or perform other Functions neceſſary to maintain Life, they ſoon periſh'd, and were loſt again. For theſe Birds we ſee can gather their Food upon Land conveniently enough notwithſtanding the Length of their Necks. For Example, Geeſe graze upon Commons, and can feed themſelves fat upon Land; yet is there not one Land Bird which hath its Neck thus diſproportionate to its Legs, nor one Water one neither,

but

but such as are destin'd by Nature in such manner as we have mention'd to search and gather their Food; for Nature makes not a long Neck to no purpose.

Lastly, Another Argument of Providence and Council relating to Animals, is the various Kinds of Voices the same Animal uses on divers Occasions, and to different Purposes. Hen Birds, for Example, have a peculiar sort of Voice when they would call the Male; which is so eminent in *Quails*, that it is taken notice of by Men, who by counterfeiting this Voice with a Quail-Pipe, easily draw the Cocks into their Snares. The common Hen, all the while she is broody, sits, and leads her Chickens, uses a Voice which we call *Clocking*; another she employs when she calls her Chickens to partake of any Food she hath found for them, upon hearing whereof they speedily run to her; another when upon sight of a Bird of Prey, or Apprehension of any Danger, she would scare them, bidding them as it were to shift for themselves, whereupon they speedily run away, and seek Shelter among Bushes, or in the thick Grass, or elsewhere dispersing themselves far and wide. These Actions do indeed necessarily infer Knowledge and Intention of, and Direction to the Ends and Uses to which they serve, not in the Birds themselves, but in a superior Agent, who hath put an Instinct in them of using such a Voice upon such an Occasion; and in the Young, of doing that upon hearing of it, which by Providence was intended. Other Voices she hath when angry, when she hath laid an Egg,

when

when in Pain or great Fear, all ſignificant; which may more eaſily be accounted for, as being Effects of the ſeveral Paſſions of Anger, Grief, Fear, Joy; which yet are all argumentative of Providence, intending their ſeveral Significations and Uſes.

I might alſo inſtance in Quadrupeds, ſome of which have as great a Diverſity of Voices as Hens themſelves, and all of them ſignificant; for Example, that common domeſtick Animal the *Cat*, as is obvious to every one to obſerve, and therefore I ſhall not ſpend Time to mention Particulars.

Object. But againſt the Uſes of ſeveral Bodies I have inſtanc'd in that refer to Man, it may be objected, that theſe Uſes were not deſign'd by Nature in the Formation of the Things, but that the Things were by the Wit of Man accommodated to thoſe Uſes.

To which I anſwer, with Dr. *More*, in the *Appendix* to his *Antidote againſt Atheiſm*, that the ſeveral uſeful Dependencies of this Kind, (*viz.* of *Stones*, *Timber*, and *Metals*, for building of Houſes or Ships, the *Magnet* for Navigation, *&c.* Fire for melting of Metals, and forging of Inſtruments for the Purpoſes mentioned) we only find, not make them. For whether we think of it or no, it is, for Example, manifeſt, that Fuel is good to continue Fire, and Fire to melt Metals, and Metals to make Inſtruments to build Ships and Houſes, and ſo on. Wherefore it being true, that there is

ſuch

ſuch a ſubordinate Uſefulneſs in the Things themſelves that are made to our Hand, it is but Reaſon in us to impute it to ſuch a Cauſe, as was aware of the Uſefulneſs and Serviceableneſs of its own Works. To which I ſhall add, that ſince we find Materials ſo fit to ſerve all the Neceſſities and Conveniencies, and to exerciſe and employ the Wit and Induſtry of an intelligent and active Being; and ſince there is ſuch an one created that is endued with Skill and Ability to uſe them, and which by their Help is enabled to rule over and ſubdue all inferior Creatures, but without them had been left neceſſitous, helpleſs, and obnoxious to Injuries above any other; and ſince the Omniſcient Creator could not but know all the Uſes, to which they might and would be employed by Man, to them that acknowledge the Being of a Deity; it is little leſs than a Demonſtration, that they were created intentionally, I do not ſay only, for thoſe Uſes.

Methinks, by all this Proviſion for the Uſe and Service of Man, the Almighty interpretatively ſpeaks to him in this Manner: I have now placed thee in a ſpacious and well-furniſh'd World; I have endued thee with an Ability of underſtanding what is beautiful and proportionable, and have made that which is ſo, agreeable and delightful to thee; I have provided thee with Materials whereon to exerciſe and employ thy Art and Strength; I have given thee an excellent Inſtrument, the Hand, accommodated to make uſe of them all; I have

distinguished the Earth into Hills and Vallies, and Plains, and Meadows, and Woods; all these Parts, capable of Culture and Improvement by thy Industry; I have committed to thee for thy Assistance in thy Labours of Plowing, and Carrying, and Drawing, and Travel, the laborious Ox, the patient Ass, and the strong and serviceable Horse; I have created a Multitude of Seeds for thee to make Choice out of them, of what is most pleasant to thy Taste, and of most wholesome and plentiful Nourishment; I have also made great Variety of Trees, bearing Fruit both for Food and Physick, those too capable of being meliorated and improved by Transplantation, Stercoration, Incision, Pruning, Watering, and other Arts and Devices. Till and manure thy Fields, sow them with thy Seeds; extirpate noxious and unprofitable Herbs; guard them from the Invasion and Spoil of Beasts; clear and fence in thy Meadows and Pastures; dress and prune thy Vines, and so rank and dispose them as is most suitable to the Climate; plant thee Orchards, with all Sorts of Fruit-Trees, in such Order as may be most beautiful to the Eye, and most comprehensive of Plants; Gardens for culinary Herbs, and all Kinds of Salleting; for delectable Flowers, to gratify the Eye with their agreeable Colours and Figures, and thy Scent with their fragrant Odours; for Odoriferous and Ever-green Shrubs and Suffrutices; for Exotick and Medicinal Plants of all Sorts; and dispose them in that comely Order, as may be both pleasant to behold, and commodious for

Acceſs. I have furniſhed thee with all Materials for Building, as Stone, and Timber, and Slate, and Lime, and Clay, and Earth, whereof to make Bricks and Tiles; deck and beſpangle the Country with Houſes and Villages convenient for thy Habitation, provided with Outhouſes and Stables for the harbouring and ſhelter of thy Cattle, with Barns and Granaries for the Reception, and Cuſtody, and ſtoring up thy Corn and Fruits. I have made thee a ſociable Creature, Ζῶον πολιτικὸν, for the Improvement of thy Underſtanding by Conference, and Communication of Obſervations and Experiments; for mutual Help, and Aſſiſtance, and Defence; build thee large Towns and Cities with ſtreight and well-pav'd Streets, and elegant Rows of Houſes, adorn'd with magnificent Temples for my Honour and Worſhip, with beautiful Palaces for thy Princes and Grandees, with ſtately Halls for publick Meetings of the Citizens and their ſeveral Companies, and the Seſſions of the Court of Judicature; beſides publick Portico's and Aquæducts. I have implanted in thy Nature a Deſire of ſeeing ſtrange and foreign, and finding out unknown Countries, for the Improvement, and Advance of thy Knowledge in *Geography*, by obſerving the Bays, and Creeks, and Havens, and Promontories, the Out-lets of Rivers, the Situation of the Maritime Towns and Cities, the Longitude and Latitude, *&c.* of thoſe Places: In *Politicks*, by noting their Government, their Manners, Laws, and Cuſtoms, their Diet and Medicines, their Trades

and Manufactures, their Houſes and Buildings, their Exerciſes and Sports, *&c.* In *Phyſiology*, or Natural Hiſtory, by ſearching out their Natural Rarities, the Productions both of Land and Water; what *Species* of Animals, Plants, and Minerals, of Fruits and Drugs are to be found here, what Commodities for Bartering and Permutation, whereby thou mayeſt be enabled to make large Additions to Natural Hiſtory, to advance thoſe other Sciences, and to benefit and enrich thy Country by Increaſe of its Trade and Merchandize. I have given thee Timber and Iron to build the Hulls of Ships, tall Trees for Maſts, Flax and Hemp for Sails, Cables, and Cordage, for Rigging. I have armed thee with Courage and Hardineſs to attempt the Seas, and traverſe the ſpacious Plains of that liquid Element. I have aſſiſted thee with a Compaſs, to direct thy Courſe when thou ſhalt be out of all Ken of Land, and have nothing in View but Sky and Water. Go thither for the Purpoſes before-mentioned, and bring Home what may be uſeful and beneficial to thy Country in general, or thy ſelf in particular.

I perſuade my ſelf, that the bountiful and gracious Author of Man's Being and Faculties, and all Things elſe, delights in the Beauty of his Creation, and is well pleaſed with the Induſtry of Man, in adorning the Earth with beautiful Cities and Caſtles; with pleaſant Villages and Country-Houſes; with regular Gardens and Orchards, and Plantations of all Sorts of Shrubs,

and Herbs, and Fruits, for Meat, Medicine, or moderate Delight; with ſhady Woods and Groves, and Walks ſet with Rows of elegant Trees; *with Paſtures cloathed with Flocks, and Valleys cover'd with Corn*, and Meadows burthened with Graſs, and whatever elſe differenceth a civil and well-cultivated Region, from a barren and deſolate Wilderneſs.

If a Country thus planted and adorn'd, thus poliſhed and civilized, thus improved to the Height by all Manner of Culture for the Support and Suſtenance, and convenient Entertainment of innumerable Multitudes of People, be not to be preferred before a barbarous and inhoſpitable *Scythia*, without Houſes, without Plantations, without Corn-fields or Vineyards, where the roving *Hords* of the ſavage and truculent Inhabitants transfer themſelves from Place to Place in Waggons, as they can find Paſture and Forage for their Cattle, and live upon Milk, and Fleſh roaſted in the Sun, at the Pomels of their Saddles; or a rude and unpoliſhed *America*, peopled with ſlothful and naked *Indians*, inſtead of well-built Houſes, living in pitiful Huts and Cabbins, made of Poles ſet end-ways; then ſurely the brute Beaſts Condition, and Manner of Living, to which, what we have mention'd doth nearly approach, is to be eſteem'd better than Man's, and Wit and Reaſon was in vain beſtowed on him.

Lastly, I might draw an Argument of the admirable Art and Skill of the Creator and Composer of them, from the incredible Smalness of some of those natural and enlivened Machines, the Body of Animals.

Any Work of Art of extraordinary Fineness and Subtlety, be it but a small Engine or Movement, or a curious carved or turned Work of Ivory or Metals, such as those Cups turned of Ivory by *Oswaldus Nerlinger* of *Suevia*, mention'd by *Joan. Faber*, in his Expositions of *Recchus* his *Mexican* Animals, which all had the perfect Form of Cups, and were gilt with a Golden Border about the Brim, of that wonderful Smalness, that *Faber* himself put a thousand of them into an excavated Pepper-corn; and when he was weary of the Work, and yet had not filled the Vessel, his Friend, *John Carlus Schad*, that shewed them him, put in four hundred more. Any such Work, I say, is beheld with Admiration, and purchased at a great Rate, and treasured up as a singular Rarity in the *Musæums* and Cabinets of the Curious, and as such is one of the first Things shewed to *Travellers* and *Strangers*. But what are these for their Fineness and Parvity (for which alone, and their Figure, they are considerable) to those minute Machines endued with Life and Motion, I mean, the Bodies of those *Animalcula*, not long since discovered in *Pepper-water*, by Mr. *Leuenhoek*, of *Delft* in *Holland*, (whose Observations were confirmed and improved by our Learned and Worthy Country-

Country-man, Dr. *Robert Hook*) who tells us, That ſome of his Friends (whoſe Teſtimonials he deſired), did affirm, That they had ſeen 10000, others 30000, others 45000 little living Creatures, in a Quantity of Water no bigger than a Grain of Millet; and yet he made it his Requeſt to them, that they would only juſtify (that they might be within compaſs) half the Number that they believed each of them ſaw in the Water. From the greateſt of theſe Numbers he infers, that there will be 8280000 of theſe living Creatures ſeen in one Drop of Water; which Number (ſaith he) I can with Truth affirm, I have diſcerned. This (proceeds he) doth exceed Belief: But I do affirm, if a large Grain of Sand were broken into 8000000 of equal Parts, one of theſe would not exceed the Bigneſs of one of thoſe Creatures. Dr. *Hook* tells us, That after he had diſcovered vaſt Multitudes of thoſe exceeding ſmall Creatures which Mr. *Leuenhoek* had deſcribed, upon making uſe of other Lights and Glaſſes, he not only magnified thoſe he had diſcovered to a very great Bigneſs, but diſcovered many other ſorts very much ſmaller than them he firſt ſaw, and ſome of them ſo exceeding ſmall, that Millions of Millions might be contain'd in one Drop of Water. If *Pliny*, conſidering ſuch Inſects as were known to him, and thoſe were none but what were viſible to the naked Eye, was moved to cry out, That the Artifice of Nature was no where more conſpicuous than in theſe. And again, *In his*

tam parvis atque tam nullis quæ ratio, quanta vis, quam inextricabilis perfectio? And again, *Rerum natura nusquam magis quàm in minimis tota est*, Hist. Nat. l. 11. c. 1. What would he have said, if he had seen Animals of so stupendous Smallness, as I have mention'd? How would he have been rapt into an Extasie of Astonishment and Admiration?

Again: If considering the Body of a Gnat, (which by his own Confession is none of the least of Insects) he could make so many admiring Queries, *Where hath Nature disposed so many Senses in a Gnat? Ubi visum prætendit? Ubi gustatum applicavit? Ubi odoratum inseruit? Ubi verò truculentam illam & portione maximam vocem ingeneravit? Quâ subtilitate pennas adnexuit? Prælongavit pedum crura? Disposuit jejunam caveam uti alvum? Avidam sanguinis & potissimum humani sitim accendit? Telum verò perfodiendo tergori quo spiculavit ingenio? Atque ut in capaci, cùm cerni non possit exilitas, ita reciproca geminavit arte, ut fodiendo acuminatum pariter sorbendoque fistulosum esset.* Which Words should I translate, would lose of their Emphasis and Elegancy; if, I say, he could make such Queries about the Members of a Gnat, what may we make, and what would he in all likelihood have made, had he seen these incredibly small living Creatures? How would he have admired the immense Subtilty (as he phrases it) of their Parts? For to use Dr. *Hook*'s Words in his *Microscopium*, p. 103. If these Creatures be so exceeding

ceeding ſmall, what muſt we think of their Muſcles and other Parts? Certain it is, that the Mechaniſm by which Nature performs the Muſcular Motion, is exceeding ſmall and curious, and to the Performance of every Muſcular Motion, in greater Animals at leaſt, there are not fewer diſtinct Parts concerned than many Millions of Millions, and theſe viſible through a Microſcope.

Uſe. Let us then conſider the Works of God, and obſerve the Operations of his Hands: Let us take notice of, and admire his infinite Wiſdom and Goodneſs in the Formation of them: No Creature in this ſublunary World is capable of ſo doing, beſides Man, and yet we are deficient herein: We content ourſelves with the Knowledge of the Tongues, or a little Skill in Philology, or Hiſtory perhaps, and Antiquity, and neglect that which to me ſeems more material, I mean, Natural Hiſtory, and the Works of the Creation: I do not diſcommend or derogate from thoſe other Studies: I ſhould betray mine own Ignorance and Weakneſs ſhould I do ſo; I only wiſh they might not altogether juſtle out, and exclude this. I wiſh that this might be brought in Faſhion among us; I wiſh Men would be ſo equal and civil, as not to diſparage, deride, and vilifie thoſe Studies which themſelves skill not of, or are not converſant in; no Knowledge can be more pleaſant than this, none that doth ſo ſatisfie and feed the Soul; in Compari-

ſon

pariſon whereto that of Words and Phraſes ſeem to me inſipid and jejune. That Learning (ſaith a wiſe and obſervant Prelate) which conſiſts only in the Form and Pedagogy of Arts, or the critical Notions upon Words and Phraſes, hath in it this intrinſical Imperfection, that it is only ſo far to be eſteemed, as it conduceth to the Knowledge of Things, being in it ſelf but a kind of Pedantry, apt to infect a Man with ſuch odd Humours of Pride, and Affectation, and Curioſity, as will render him unfit for any great Employment. Words being but the Images and Matter, to be wholly given up to the Study of theſe, what is it but *Pygmalion*'s Frenzy, to fall in Love with a Picture or Image? As for *Oratory*, which is the beſt Skill about Words, that hath by ſome wiſe Men been eſteem'd, but a voluntary Art, like to Cookery, which ſpoils wholeſome Meats, and helps unwholeſome, by the Variety of Sauces, ſerving more to the Pleaſure of Taſte, than the Health of the Body.

It may be (for ought I know, and as ſome Divines have thought) part of our Buſineſs and Employment in Eternity, to contemplate the Works of God, and to give him the Glory of his Wiſdom, Power, and Goodneſs, manifeſted in the Creation of them. I am ſure it is part of the Buſineſs of a Sabbath-day, and the Sabbath is a Type of that Eternal Reſt; for the Sabbath ſeems to have been firſt inſtituted for a Commemoration of the Works of the

the Creation, from which God is ſaid to have reſted upon the Seventh Day.

It is not likely that Eternal Life ſhall be a torpid and unactive State, or that it ſhall conſiſt only in an uninterrupted and endleſs Act of Love; the other Faculties ſhall be employ'd as well as the Will in Actions ſuitable to and perfective of their Natures; eſpecially the Underſtanding, the ſupreme Faculty of the Soul, which chiefly differenceth us from brute Beaſts, and makes us capable of Virtue and Vice, of Rewards and Puniſhments, ſhall be buſy'd and employ'd in contemplating the Works of God, and obſerving the divine Art and Wiſdom, manifeſted in the Structure and Compoſition of them, and reflecting upon their great Architect the Praiſe and Glory due to him; then ſhall we clearly ſee, to our great Satisfaction and Admiration, the Ends and Uſes of theſe things, which here were either too ſubtle for us to penetrate and diſcover, or too remote and unacceſſible for us to come to any diſtinct View of, *viz.* the Planets and fixed Stars, thoſe illuſtrious Bodies, whoſe Contents and Inhabitants, whoſe Stores and Furniture, we have here ſo longing a Deſire to know, as alſo their mutual Subſerviency to each other. Now the Mind of Man being not capable at once to advert to more than one thing, a particular View and Examination of ſuch an innumerable Number of vaſt Bodies, and the great Multitude of *Species*, both of animate and inanimate Beings,

which

which each of them contains, will afford Matter enough to exercise and employ our Minds, I do not say to all Eternity, but to many Ages, should we do nothing else.

Let it not suffice us to be Book-learn'd, to read what others have written, and to take upon Trust more Falshood than Truth; but let us our selves examine Things as we have Opportunity, and converse with Nature as well as Books. Let us endeavour to promote and increase this Knowledge, and make new Discoveries, not so much distrusting our own Parts, or despairing of our own Abilities, as to think that our Industry can add nothing to the Invention of our Ancestors, or correct any of their Mistakes. Let us not think that the Bounds of Science are fixed, like *Hercules*'s Pillars, and inscrib'd with a *Ne plus ultra*; let us not think we have done when we have learn'd what they have deliver'd to us; the Treasures of Nature are inexhaustible; here is Employment enough for the vastest Parts, the most indefatigable Industries, the happiest Opportunities, the most prolix and undisturb'd Vacancies. *Multa venientis ævi populus ignota nobis sciet: Multa sæculis tunc futuris, cum memoria nostri exoleverit reservantur. Pusilla res mundus est, nisi in eo quod quærat omnis mundus habeat.* Seneca Nat. Quæst. Lib. 7. Cap. 31. *The People of the next Age shall know many things unknown to us: Many are reserv'd for Ages then to come, when we shall be quite forgotten, no Memory of us remaining.*

ing. The World would be a pitiful small thing indeed, if it did not contain enough for the Enquiries of the whole World. Yet, and again, *Epist.* 64. *Multum adhuc restat Operis, multumque restabit, nec ulli nato post mille sæcula præcludetur occasio aliquid adhuc adjiciendi. Much Work still remains, and much will remain; neither to him that shall be born after a thousand Ages, will Matter be wanting for new Additions to what hath already been invented.* Much might be done would we but endeavour, and nothing is insuperable to Pains and Patience. I know that a new Study at first seems very vast, intricate, and difficult; but after a little Resolution and Progress, after a Man becomes a little acquainted, as I may so say, with it, his Understanding is wonderfully clear'd up and enlarg'd, the Difficulties vanish, and the thing grows easy and familiar. And for our Encouragement in this Study, observe what the Psalmist saith, *Psal.* cxi. 2. *The Works of the Lord are great, sought out of all them that have Pleasure therein.* Which tho' it be principally spoken of the Works of Providence, yet may as well be verify'd of the Works of the Creation. I am sorry to see so little Account made of real experimental Philosophy in this * University, and that those ingenious Sciences of the Mathematicks are so much neglected by us; and therefore do earnestly exhort those that are young, especially Gentlemen, to set upon these Studies; they may possibly invent something

* Cambridge, *where the Author liv'd at the first writing of this.*

ſomething of eminent Uſe and Advantage to the World; and one ſuch Diſcovery would abundantly compenſate the Expence and Travel of one Man's whole Life. However, it is enough to maintain and continue what is already invented; neither do I ſee what more ingenious and manly Employment they can purſue, tending more to the Satisfaction of their own Minds, and the Illuſtration of the Glory of God, for he is wonderful in all his Works.

But I would not have any Man croſs his natural Genius or Inclinations, or undertake ſuch Methods of Study as his Parts are not fitted to, or not ſerve thoſe Ends to which his Friends, upon mature Deliberation, have deſign'd him; but thoſe who do abound with Leiſure, or who have a natural Propenſion and Genius inclining them thereto; or thoſe who by reaſon of the Strength and Greatneſs of their Parts, are able to compaſs and comprehend the whole Latitude of Learning.

Neither yet need thoſe who are deſign'd to Divinity it ſelf fear to look into theſe Studies, or think they will engroſs their whole Time, and that no conſiderable Progreſs can be made therein, unleſs Men lay aſide and neglect their ordinary Callings and neceſſary Employments. No ſuch Matter. Our Life is long enough, and we might find Time enough did we huſband it well: *Vitam non accepimus brevem, ſed fecimus,*

fecimus, nec inopes ejus, sed prodigi sumus, as *Seneca* saith, *We have not received a short Life, but have made it so; neither do we want Time, but are prodigal of it.* And did but young Men fill up that Time with these Studies, which lies upon their Hands, which they are incumber'd with, and troubled how to pass away, much might be done even so. I do not see but the Study of true Physiology may be justly accounted a proper, or Προπαιδεία Preparative to Divinity. But to leave that, it is a generally receiv'd Opinion, that all this visible World was created for Man; that Man is the End of the Creation; as if there were no other End of any Creature, but some way or other to be serviceable to Man. This Opinion is as old as *Tully*; for, saith he, in his Second Book, *De Nat. Deorum. Principio ipse Mundus Deorum hominumque causâ factus est: quæque in eo sunt omnia ea parata ad fructum hominum & inventa sunt.* But tho' this be vulgarly receiv'd, yet wise Men now-a-days think otherwise. Dr. *More* affirms, * *That Creatures are made to enjoy themselves as well as to serve us; and that it is a gross piece of Ignorance and Rusticity to think otherwise.* And in another Place: *This comes only out of Pride and Ignorance, or a haughty Presumption; because we are encourag'd to believe that in some Sense all Things are made for Man, therefore to think that they are not at all made for themselves. But he that pronounceth this, is ignorant of the Nature of Man, and the Knowledge of Things:*

* Antidot. Atheism, *l.* 2. *c.* 11.

Things: For if a good Man be merciful to his Beaſt, then ſurely a good God is bountiful and benign, and takes Pleaſure that all his Creatures enjoy themſelves, that have Life and Senſe, and are capable of Enjoyment.

Thoſe Philoſophers indeed who hold Man to be the only Creature in this ſublunary World endu'd with Senſe and Perception, and that all other Animals are mere Machines or Puppets, have ſome reaſon to think that all Things here below were made for Man. But this Opinion ſeems to me too mean, and unworthy the Majeſty, Wiſdom, and Power of God; nor can it well conſiſt with his Veracity, inſtead of a Multitude of noble Creatures, endu'd with Life and Senſe, and ſpontaneous Motion, as all Mankind till of late Years believ'd, and none ever doubted of (ſo that it ſeems we are naturally made to think ſo) to have ſtock'd the Earth with divers Sets of *Automata*, without all Senſe and Perception, being wholly acted from without, by the Impulſe of external Objects.

But be this ſo, there are infinite other Creatures without this Earth, which no conſiderate Man can think were made only for Man, and have no other Uſe. For my part, I cannot believe that all Things in the World were ſo made for Man, that they have no other Uſe.

For

For it seems to me highly absurd and unreasonable, to think that Bodies of such vast Magnitude as the fix'd Stars, were only made to twinkle to us, nay, a Multitude of them there are, that do not so much as twinkle, being either by reason of their Distance, or of their Smalness, altogether invisible to the naked Eye, and only discoverable by a Telescope; and it is likely, perfecter Telescopes than we yet have, may bring to light many more; and who knows, how many lie out of the Ken of the best Telescope that can possibly be made? And, I believe, there are many Species in Nature, even in this sublunary World, which were never yet taken Notice of by Man, and consequently of no Use to him, which yet we are not to think were created in vain; but may be found out by, and of Use to, those who shall live after us in future Ages. But though in this Sense it be not true, that all Things were made for Man; yet, thus far it is that all the Creatures in the World may be some way or other Useful to us, at least to exercise our Wits and Understandings, in considering and contemplating of them, and so afford us Subject of admiring and glorifying their and our Maker. Seeing then, we do believe, and assert, that all Things were in some Sense made for us, we are thereby oblig'd to make use of them for those Purposes for which they serve us, else we frustrate this End of their Creation. Now some of them serve only to exercise our Minds: Many others there be, which

might probably ſerve us to good Purpoſe, whoſe Uſes are not diſcovered, nor are they ever like to be, without Pains and Induſtry. True it is, many of the greateſt Inventions have been accidentally ſtumbled upon; but not by Men ſupine and careleſs, but buſy and inquiſitive. Some Reproach methinks it is to learned Men, that there ſhould be ſo many Animals in the World, whoſe outward Shape is not yet taken Notice of, or deſcrib'd, much leſs their Way of Generation, Food, Manners, Uſes, obſerved.

The Scripture, *Pſal.* 148. calls upon *the Sun, Moon, and Stars, Fire and Hail, Snow and Vapour, ſtormy Winds and Tempeſts, Mountains and all Hills, fruitful Trees, and all Cedars, Beaſts and all Cattle, creeping Things and flying Fowl,* &c. *to praiſe the Lord.* How can that be? Can ſenſeleſs and inanimate Things praiſe God? ſuch as are the Sun, and Moon, and Stars. And although Beaſts be advanced higher to ſome Degree of Senſe and Perception; yet being void of Reaſon and Underſtanding, they know nothing of the Cauſes of Things, or of the Author and Maker of themſelves, and other Creatures. All that they are capable of doing, in reference to the praiſing of God, is (as I ſaid before) by affording Matter, or Subject, of praiſing him, to rational and intelligent Beings. So the Pſalmiſt, *Pſal.* xix. 1. *The Heavens declare the Glory of God, and the Firmament ſheweth his Handy-work.* And therefore the *Pſalmiſt*, when he calls upon

Sun, and Moon, and Stars, to praiſe God, doth in effect call upon Men and Angels, and other rational Beings, to conſider thoſe great Effects of the divine Power and Wiſdom, their vaſt Dimenſions, their regular Motions and Periods, their admirable Diſpoſition and Order, their eminent Ends and Uſes in illuminating and enlivening the Planets, and other Bodies about them, and their Inhabitants, by their comfortable and cheriſhing Light, Heat, and Influences, and to give God the Glory of his Power, in making ſuch great and illuſtrious Bodies, and of his Wiſdom and Goodneſs in ſo placing and diſpoſing of them, ſo moving them regularly and conſtantly, without claſhing, or interfering, one with another, and enduing them with ſuch excellent Virtues and Properties, as to render them ſo ſerviceable and beneficial to Man, and all other Creatures about them.

The like may be ſaid of Fire, Hail, Snow, and other Elements and Meteors, of Trees, and other Vegetables, of Beaſts, Birds, Inſects, and all Animals, when they are commanded to praiſe God, which they cannot do by themſelves; Man is commanded to conſider them particularly, to obſerve and take notice of their curious Structure, Ends, and Uſes, and give God the Praiſe of his Wiſdom, and other Attributes therein manifeſted.

And therefore those who have Leisure, Opportunity, and Abilities, to contemplate and consider any of these Creatures, if they do it not, do as it were rob God of some Part of his Glory, in neglecting or slighting so eminent a Subject of it, and wherein they might have discovered so much Art, Wisdom, and Contrivance.

And it is particularly remarkable, that the Divine Author of this *Psalm*, amongst other Creatures, calls upon Insects also to praise God; which is as much as to say, Ye Sons of Men, neglect none of his Works, those which seem most vile and contemptible: there is Praise belongs to him for them. Think not that any Thing he hath vouchsafed to create, is unworthy thy Cognizance, to be slighted by thee. It is Pride and Arrogance, or Ignorance and Folly, in thee so to think. There is a greater Depth of Art and Skill in the Structure of the meanest Insect, than thou art able for to fathom, or comprehend.

The Wisdom, Art, and Power of Almighty God, shines forth as visibly in the Structure of the Body of the minutest Insect, as in that of a Horse, or Elephant: Therefore God is said to be, *Maximus in minimis.* We Men esteem it a more difficult Matter, and of greater Art and Curiosity, to frame a small Watch, than a large Clock:

And no Man blames him who ſpent his whole Time in the Conſideration of the Nature and Works of a Bee, or thinks his Subject was too narrow. Let us not then eſteem any Thing contemptible, or inconſiderable, or below our notice taking; for this is to derogate from the Wiſdom and Art of the Creator, and to confeſs ourſelves unworthy of thoſe Endowments of Knowledge and Underſtanding which he hath beſtowed on us. Do we praiſe *Dædalus*, and *Architas*, and *Hero*, and *Callicrates*, and *Albertus Magnus*, and many others which I might mention, for their Cunning in inventing, and Dexterity in framing and compoſing a few dead Engines, or Movements, and ſhall we not admire and magnify the Great Δημιεργὸς Κόσμε, *Former of the World*, who hath made ſo many, yea, I may ſay, innumerable, rare Pieces, and thoſe too not dead Ones, ſuch as ceaſe preſently to move ſo ſoon as the Spring is down; but all living, and themſelves performing their own Motions, and thoſe ſo intricate and various, and requiring ſuch a Multitude of Parts and ſubordinate Machines, that it is incomprehenſible what Art and Skill, and Induſtry, muſt be employed in the framing of one of them?

I have already noted out of Dr. *Hook*, that to the Performance of every Muſcular Motion, at leaſt in greater Animals, there are not fewer diſtinct Parts concerned, than many Millions of Millions.

Further, from the Consideration of our own Smallness and Inconsiderableness, in respect of the Greatness and Splendor of those glorious heavenly Bodies, the Sun, Moon, and Stars, to which our Bodies bear no Proportion at all either in Magnitude, or Lustre; let us with the Holy *Psalmist* raise up our Hearts to magnify the Goodness of God towards us in taking such Notice of us, and making such Provision for us, and advancing us so highly above all his Works, *Psal.* viii. 3. *When I consider the Heavens, the Work of thy Fingers, the Moon and the Stars which thou hast ordained. What is Man that thou art mindful of him, and the Son of Man that thou visitest him? For thou hast made him a little lower than the Angels, and hast crowned him with Glory and Honour*, &c.

But it may be objected, that God Almighty was not so selfish and desirous of Glory, as to make the World, and all the Creatures therein, only for his own Honour, and to be praised by Man. To assert this, were, in *Des Cartes*'s Opinion, an absurd and childish Thing, and a resembling of God to a proud Man. It is more worthy the Deity, to attribute the Creation of the World, to the Exundation and Overflowing of his transcendent and infinite Goodness, which is of its own Nature, and in the very Notion of it, most free, diffusive, and communicative.

To

To this I shall answer in two Words; First, The Testimony of Scripture makes God in all his Actions to intend and design his own Glory mainly, *Prov.* xvi. 4. *God made all Things for himself.* How! for himself? He hath no Need of them: He hath no Use of them. No, he made them for the manifestation of his Power, Wisdom, and Goodness, and that he might receive from the Creatures that were able to take Notice thereof, his Tribute of Praise, *Psal.* l. 14. *Offer unto God Thanksgiving.* And in the next Verse, *I will deliver thee, and thou shalt glorify me.* And again in the last Verse, *Whoso offereth Praise, glorifieth me.* So Praise is called a Sacrifice, and *the Calves of the Lips*, Hos. xiv. 2. Isa. xlii. 8. *I am the Lord, that is my Name, and my Glory will I not give to another.* Isa. xlviii. 11. *And I will not give my Glory to another.* The Scripture calls upon the Heavens, the Earth, and Sun, and Moon, and Stars, and all other Creatures, to praise the Lord; that is, by the Mouth of Man, (as I shewed before) who is hereby required to take notice of all these Creatures, and to admire and praise the Power, Wisdom, and Goodness of God, manifested in the Creation and Designations of them.

Secondly, It is most reasonable that God Almighty should intend his own Glory: For he being infinite in all Excellencies and Perfections, and independent upon any other Being;

nothing can be said or thought of him too Great, and which he may not justly challenge as his due; nay, he cannot think too highly of himself, his other Attributes being adequate to his Understanding; so that, though his Understanding be infinite, yet he understands no more than his Power can effect, because that is infinite also. And therefore it is fit and reasonable, that he should own and accept the Creatures Acknowledgments and Celebrations of those Virtues and Perfections, which he hath not received of any other, but possesseth eternally and originally of himself. And indeed, (with Reverence be it spoken) what else can we imagine the ever-blessed Deity to delight and take Complacency in for ever, but his own infinite Excellencies and Perfections, and the Manifestations and Effects of them, the Works of the Creation, and the Sacrifices of Praise and Thanks offered up by such of his Creatures as are capable of considering those Works, and discerning the Traces and Footsteps of his Power and Wisdom appearing in the Formation of them; and moreover, whose bounden Duty it is so to do? The Reason why Man ought not to admire himself, or seek his own Glory, is, because he is a Dependent Creature, and hath nothing but what he hath received; and not only dependent, but imperfect; yea, weak and impotent: And yet I do not take Humility in Man to consist in disowning, or denying any Gift or Ability that is in him, but in a just Valuation of such Gifts and Endowments, yet rather thinking too meanly than too highly

highly of them; becauſe human Nature is ſo apt to err in running into the other Extreme, to flatter it ſelf, and to accept thoſe Praiſes that are not due to it; Pride being an Elation of Spirit upon falſe Grounds, or a Deſire and Acceptance of undue Honour. Otherwiſe, I do not ſee why a Man may not admit, and accept the Teſtimonies of others, concerning any Perfection, Accompliſhment, or Skill, that he is really poſſeſſed of, yet can he not think of himſelf to deſerve any Praiſe or Honour for it, becauſe both the Power and the Habit are the Gift of God: And conſidering that one Virtue is counter-balanced by many Vices, and one Skill or Perfection with much Ignorance and Infirmity.

The End of the Firſt Part.

The SECOND PART of the

WISDOM of GOD

Manifested in the

WORKS

OF THE

CREATION.

Particularly in the

I. Whole Body of the EARTH.
II. Bodies of MAN,
And other ANIMALS.

THE WISDOM of GOD Manifested in the WORKS OF THE CREATION.

PART II.

I Proceed now to select some particular Pieces of the Creation, and to consider them more distinctly. They shall be only two.

I. The whole Body of the Earth.
II. The Body of Man.

First, The Body of the Earth; and therein I shall take notice of, 1. Its Figure. 2. Its Motion. 3. The Constitution of its Parts.

By

By Earth I here underſtand not the dry Land, or the Earth contradiſtinguiſh'd to Water, or the Earth conſider'd as an Element, but the whole *terraqueous* Globe, compoſed of Earth and Water.

1. For the *Figure*, I could eaſily demonſtrate it to be ſpherical. That the Water, which by reaſon of its Fluidity ſhould, one would think, compoſe it ſelf to a Level, yet doth not ſo, but hath a gibboſe *Superficies*, may to the Eye be demonſtrated upon the Sea. For when two Ships ſailing contrary ways loſe the ſight one of another, firſt the Keel and Hull diſappear, afterwards the Sails; and if when upon the Deck you have perfectly loſt ſight of all, you get up to the top of the Main-Maſt, you may deſcry it again. Now what ſhould take away the ſight of theſe Ships from each other but the Gibboſity of the interjacent Water? The Roundneſs of the Earth from North to South is demonſtrated from the appearance of northern Stars above the Horizon, and loſs of the ſouthern to them that travel northward; and on the contrary, the loſs of the northern, and appearance of the ſouthern to them that travel ſouthward. For were the Earth a Plain, we ſhould ſee exactly the ſame Stars wherever we were placed on that Plain. The Roundneſs from Eaſt to Weſt is demonſtrated from *Eclipſes* of either of the great *Luminaries*. For why the ſame *Eclipſe*, ſuppoſe of the *Sun*, which is ſeen to them that live more eaſterly, when the Sun is elevated ſix Degrees above the

the Horizon, ſhould be ſeen to them that live one degree more weſterly, when the Sun is but five Degrees above the Horizon, and ſo lower and lower proportionably to them that live more and more weſterly, till at laſt it appear not at all, no Account can be given but the Globoſity of the Earth. For were the Earth a perfect Plain, the Sun would appear eclips'd to all that live upon that Plain, if not exactly in the ſame Elevation, yet pretty near it; but to be ſure it would never appear to ſome, the Sun being elevated high above the Horizon; and not at all to others. It being clear then that the Figure of the Earth is ſpherical, let us conſider the Conveniences of this Figure.

1. No Figure is ſo capacious as this, and conſequently whoſe Parts are ſo well compacted and united, and lie ſo near one to another for mutual Strength. Now the Earth, which is the Baſis of all Animals, and, as ſome think, of the whole Creation, ought to be firm, and ſtable, and ſolid, and as much as is poſſible ſecur'd from all Ruins and Concuſſions.

2. This Figure is moſt conſonant and agreeable to the natural *Nutus*, or Tendency of all heavy Bodies. Now the Earth being ſuch a one, and all its Parts having an equal Propenſion or Connivency to the Center, they muſt needs be in greateſt Reſt, and moſt immoveable, when they are all equidiſtant from it; whereas were it an angular

angular Body, all the Angles would be vaſt and ſteep Mountains, bearing a conſiderable Proportion to the whole Bulk, and therefore thoſe Parts being extremely more remote from the Center than thoſe about the middle of the Plains, would conſequently preſs very ſtrongly thitherward, and unleſs the Earth were made of Adamant or Marble, in time the other Parts would give way, till all were levell'd.

3. Were the Earth an angular Body, and not round, all the whole Earth would be nothing elſe but vaſt Mountains, and ſo incommodious for Animals to live upon, for the middle Point of every Side would be nearer the Center than any other, and conſequently from that Point, which way ſoever one travell'd, would be up-hill, the Tendency of all heavy Bodies being perpendicularly to the Center; beſides, how much this would obſtruct Commerce, is eaſily ſeen; for not only the Declivity of all Places would render them very difficult to be travell'd over, but likewiſe the midſt of every Side being loweſt and neareſt the Center, if there were any Rain, or any Rivers, muſt needs be fill'd with a Lake of Water, there being no way to diſcharge it, and poſſibly the Water would riſe ſo high as to overflow the whole *Latus*. But, ſurely, there would be much more Danger of the Inundation of whole Countries than now there is, all the Waters falling upon the Earth, by reaſon of its Declivity every way, eaſily deſcending down to the

the common Receptacle the Sea. And these Lakes of Water being far distant one from another, there could be no Commerce between far remote Countries, but by Land.

4. A Spherical Figure is most commodious for *Dinetial* Motion, or Revolution, upon its own *Axis*; for in that, neither can the Medium at all resist the Motion of the Body, because it stands not in its way, no Part coming into any Space but what the Precedent left, neither doth one Part of the Superficies move faster than another: Whereas were it Angular, the Parts about the Angles would find strong Resistance from the Air, and those Parts also about the Angles would move much faster than those about the Middle of the Planes, being remoter from the Center than they. It remains therefore that this Figure is the most commodious for Motion.

Here I cannot but take Notice of the Folly and Stupidity of the *Epicureans*, who fancied the Earth to be flat and contiguous to the Heavens on all Sides, that it descended a great way with long Roots; and that the Sun was new made every Morning, and not much bigger than it seems to the Eye, and of a flat Figure, and many other such gross Absurdities as Children among us would be ashamed of.

Secondly,, I come now to speak of the *Motion* of the *Earth*. That the *Earth* (speaking according to Philosophical Accurateness) doth

move both upon its own Poles, and in the *Ecliptick*, is now the received Opinion of the moſt learned and skilful *Mathematicians*. To prove the Diurnal Motion of it upon its Poles, I need produce no other Argument than, *Firſt*, The vaſt Diſproportion in reſpect of Magnitude, that is between the Earth and the Heavens, and the great Unlikelihood that ſuch an infinite Number of vaſt Bodies ſhould move about ſo inconſiderable a Spot as the Earth, which in Compariſon with them, by the concurrent Suffrages of Mathematicians of both Perſwaſions, is a mere Point, that is, next to nothing. *Secondly*, The immenſe and incredible Celerity of the Motion of the Heavenly Bodies in the ancient *Hypotheſis*. *Thirdly*, Of its Annual Motion in the Ecliptick, the Stations and Retrogradations of the ſuperior Planets are a convincing Argument, there being a clear and facile Account thereof to be given from the mere Motion of the Earth in the *Ecliptick*; whereas in the old *Hypotheſis* no Account can be given, but by the unreaſonable Fiction of *Epicycles*, and contrary Motions; add hereto, the great Unlikelihood of ſuch an enormous *Epicycle* as *Venus* muſt deſcribe about the Sun, not under the Sun, as the old Aſtronomers fancied. About the Sun, I ſay, as appears by its being hid or eclipſed by it, and by its ſeveral *Phaſes*, like the *Moon*. So that whoſoever doth clearly underſtand both *Hypotheſes*, cannot, I perſwade my ſelf, adhere to the Old, and reject the

the New, without doing ſome Violence to his Faculties.

Againſt this Opinion lie two Objections, *Firſt*, That it is contrary to Senſe, and the common Opinion and Belief of Mankind. *Secondly*, That it ſeemeth contrary to ſome Expreſſions in *Scripture*. To the firſt I anſwer, That our Senſes are ſometimes miſtaken, and what appears to them is not always in reality ſo as it appears. For Example: The Sun, or Moon, appear no bigger, at moſt, than a Cart-wheel, and of a flat Figure. The Earth ſeems to be plain: The Heavens to cover it like a Canopy, and to be contiguous to it round about: A Fire-brand nimbly moved round, appears like a Circle of Fire; and to give a parallel Inſtance, a Boat lying ſtill at Anchor in a River, to him that Sails and Rows by it, ſeems to move apace; and when the Clouds paſs nimbly under the Moon, the Moon it ſelf ſeems to move the contrary way. And there have been whole Books written in Confutation of vulgar Errors. *Secondly*, As to the *Scripture*, when ſpeaking of theſe Things, it accommodates it ſelf to the common and received Opinions, and employs the uſual Phraſes and Forms of Speech (as all wiſe Men alſo do, though, in Strictneſs, they be of a different or contrary Opinion) without Intention of delivering any thing Doctrinally concerning theſe Points, or confuting the contrary: And yet by thoſe that maintain the Opinion of the Earth's Motion, there might a convenient

Interpretation be given of such Places as seem to contradict it. Howbeit, because some pious Persons may be offended at such an Opinion, as savouring of Novelty, thinking it inconsistent with Divine Revelation, I shall not positively assert it, only propose it as an *Hypothesis* not altogether improbable. Supposing then, that the Earth doth move about upon its own Poles, and in the Ecliptick about the Sun, I shall shew how admirably its Situation and Motion are contrived for the Conveniency of Man, and other Animals: Which I cannot do more fully and clearly than Dr. *More* hath already done in his *Antidote against Atheism*, whose Words therefore I shall borrow.

First, Speaking of the *Parallelism* of the *Axis* of the *Earth*, he saith, I demand whether it be better to have the *Axis* of the Earth steady and perpetually parallel to it self, or to have it carelessly tumble this way and that way as it happens, or at least very variously and intricately? And you cannot but answer me, it is better to have it steady and parallel; for in this lies the necessary Foundation of the Art of Navigation and Dialling. For that steady Stream of Particles, which is supposed to keep the *Axis* of the *Earth* parallel to it self, affords the Mariner both his *Cynosura*, and his *Compass*. The *Load-stone* and the *Load-star* depend both upon this. The *Load-stone*, as I could demonstrate, were it not too great a Digression; and the *Load-star*, because that which keeps the *Axis* parallel to it self,

makes each of the *Poles* constantly respect such a Point in the Heavens; as for Example, the *North-Pole* to point almost directly to that which we call the *Pole-star*. And besides, *Dialling* could not be at all without this Steadiness of the *Axis*. But both these Arts are pleasant, and one especially of mighty Importance to Mankind. For thus there is an orderly Measuring of our Time for Affairs at home, and an Opportunity of Traffick abroad, with the most remote Nations of the World, and so there is a mutual Supply of the several Commodities of all Countries, besides the enlarging our Understandings by so ample Experience we get both of Men and Things. Wherefore if we were rationally to consult, whether the *Axis* of the *Earth* were better be held steady and parallel to it self, or left at random, we would conclude it ought to be steady, and so we find it *de Facto*, though the Earth move floating in the Liquid *Heavens*. So that appealing to our own Faculties we are to affirm, That the constant Direction of the *Axis* of the *Earth* was established by a Principle of Wisdom and Council.

Again, There being several Postures of this steady Direction of the *Axis* of the *Earth*, *viz.* either perpendicular to a Plane, going through the Center of the *Sun*, or Co-incident, or Inclining, I demand which of all these Reason and Knowledge would make choice of? Not of a perpendicular Posture; for so both the pleasant Variety, and great Convenience of Summer and

Winter, Spring and Autumn, would be loſt, and for want of Acceſſion of the Sun, theſe Parts of the Earth, which now bring forth Fruits, and are Habitable, would be in an Incapacity of ever bringing forth any; ſith then, the Heat could never be greater than now it is at our 10th of *March*, or the 11th of *September*, and therefore not ſufficient to bring their Fruits and Grain to Maturity, and conſequently could entertain no Inhabitants; and thoſe Parts that the full Heat of the Sun could reach, he plying them always alike without any annual Receſſion, or Intermiſſion, would at laſt grow tired, or exhauſted, or be wholly dried up, and want Moiſture, the Sun diſſipating and caſting off the Clouds Northwards and Southwards. Beſides, we obſerve that an orderly Viciſſitude of Things, doth much more gratifie the Contemplative Property in Man.

And now in the ſecond Place, neither would Reaſon make choice of a co-incident Poſition. For if the *Axis* thus lay in a Plane that goeth through the Center of the *Sun*, the *Ecliptick* would, like a *Colure*, or one of the *Meridians*, paſs through the *Poles* of the Earth, which would put the Inhabitants of the World into a pitiful Condition. For they that eſcape beſt in the *Temperate Zone*, would be accloyed with long Nights very tedious, no leſs than forty Days, and thoſe that now never have their Night above twenty-four Hours, as *Frieſland*, *Iceland*,

Iceland, the furtheſt Parts of *Ruſſia* and *Norway*, would be deprived of the Sun, above an Hundred and Thirty Days together. Our ſelves in *England*, and the reſt of the ſame Clime, would be cloſed up in Darkneſs no leſs than a Hundred, or Eighty Days; and ſo proportionably of the reſt, both in and out of the *Temperate Zones*. And as for Summer and Winter, though thoſe Viciſſitudes would be, yet it could not but cauſe raging Diſeaſes, to have the Sun ſtay ſo long, deſcribing his little Circles ſo near the Poles, and lying ſo hot on the Inhabitants, that had been in ſo long Extremity of Darkneſs and Cold before.

It remains therefore, that the Poſture of the *Axis* of the Earth be inclining, not perpendicular, not co-incident to the fore-mention'd Plane. And verily, it is not only inclining, but in ſo fit a Proportion, and there can be no fitter imagined to make it, to the utmoſt Capacity, as well pleaſant as habitable. For though the Courſe of the Sun be curbed between the Tropicks, yet are not thoſe Parts directly ſubject to his perpendicular Beams, either Unhabitable, or extremely Hot, as the Ancients fancied: By the Teſtimony of Travellers, and particularly Sir *Walter Raleigh*, the Parts under and near the Line, being as fruitful and pleaſant, and fit to make a Paradiſe of, as any in the World. And that they are as ſuitable to the Nature of Man, and as convenient to live in, appears from the

Longævity of the Natives; as for Inſtance, the *Æthiopes*, called by the Ancients Μακρόβιοι; but eſpecially in the *Braſilians* in *America*, the ordinary Term of whoſe Life is a Hundred Years, as is ſet down by *Piſo*, a Learned Phyſician of *Holland*, who travelled thither on purpoſe to augment Natural Knowledge, but eſpecially what related to Phyſick. And reaſonable it is that this ſhould be ſo; for neither doth the Sun lie long upon them, their Day being but Twelve Hours, and their Night as long, to cool and refreſh them: And beſides, they have frequent Showers, and conſtant Breezes, or freſh Gales of Wind from the *Eaſt*. It was the Opinion of *Aſclepiades*, as *Plutarch* reports, that generally the Inhabitants of Cold Countries are longer liv'd than thoſe of Hot, becauſe the Cold keeps in the Natural Heat, as it were locking up the Pores to prevent its Evaporation; whereas in Hot Regions the Heat is eaſily diſſipated, the Pores being large and open to give it way. Which Opinion, becauſe I find ſome Learned Men ſtill to adhere to, I ſhall produce ſome further Inſtances out of Monſieur *Rochefort*'s Hiſtory of the *Antilles* Iſlands, to confirm the contrary, and to ſhew how often and eaſily we may be deceiv'd, if we truſt to our own Ratiocinations, how plauſible ſoever, and conſult not Experience.

The ordinary Life (ſaith he) of our *Caribbeans* is an Hundred and Fifty Years long, and ſometimes more. There were ſome among them not long ſince living, who remembred to have

ſeen

ſeen the firſt *Spaniards* that boarded *America*, who we may thence conclude, liv'd to be at leaſt 160 Years old.

The *Hollanders* who traffick in the *Molucca* Iſlands, aſſure us, that the ordinary term of Life of the Natives there is one hundred and thirty Years.

Vincent le Blanc tells us, that in *Sumatra*, *Java*, and the neighbouring Iſlands, the Life of the Inhabitants is extended to 140 Years, and that in the Realm of *Caſſuby* it reaches 150. *Francis Pirara* promotes the Life of the *Braſilians* beyond the Term we have ſet it, *v. g.* to 160 Years or more, and ſays that in *Florida* and *Jucatan* there are Men found who paſs that Age. And it is ſaid, that the *French* in *Laudonior*'s Voyage into *Florida*, *Anno* 1564. ſaw a certain old Man, who affirmed himſelf to be three hundred Years old, and the Father of five Generations; *And well he might be of double that number.*

Laſtly, *Mapheous* reports, that a certain *Bengaliſe* vaunted himſelf to be 335 Years old. So far Monſieur *Rochefort*. Indeed theſe two laſt Inſtances, being perchance ſingular and extraordinary, do not prove the Point; for even among us, where the ordinary term of Life is about threeſcore and ten, or fourſcore, there occur ſome rare Inſtances of Perſons, who have lived 130, 140, 150 Years and more. But the other Teſtimonies being general, prove it beyond contradiction; neither yet is the thing in it ſelf impro-

improbable; for there being not so great Inequality of Weather in those hot Countries, as there is in cold, the Body is kept in a more equal Temper, and not having such frequent Shocks, as are occasion'd by such Air, and often Changes, and that from one Extreme to another, holds out much longer. So we see infirm and crazy Persons, when they come to be so weak as to be fixed to their Beds, hold out many Years, some I have heard of, that have laid bed-rid 20 Years: Because in the Bed they are always kept in an almost equal Temper of Heat, who, had they been exposed to the Excesses of Heat and Cold, would not probaby have survived one.

Seeing then, this best posture which our Reason could make choice of, we see really established in Nature, we cannot but acknowledge it to be the issue of Wisdom, Counsel, and Providence. Moreover, a further Argument to evince this is, That though it cannot but be acknowledged, that if the *Axis* of the Earth were perpendicular to the Plane of the Ecliptick, her Motion would be more easy and natural, yet notwithstanding, for the Conveniences forementioned, we see it is made in an inclining posture.

Another very considerable, and heretofore unobserv'd Convenience of this inclination of the Earth's *Axis*, Mr. *Keill* affords us in *his Examination of Dr.* Burnet's *Theory of the Earth*, p. 69.

There

There is (ſaith he) one more [beſides what he had mentioned before] conſiderable Advantage, which we reap by the preſent Poſition of the Earth, which I will here inſert, becauſe I do not know that it is taken notice of by any; and it is, that by the preſent Inclination of the Earth's *Axis* to the Plane of the *Ecliptick*, we who live beyond 45 Degrees of Latitude, and ſtand moſt in need of it, have more of the Sun's Heat throughout the Year than if he had ſhin'd always in the *Equator*; that is, if we take the Sum of the Sun's Actions upon us both in Summer and Winter, they are greater than its Heat would be if he moved always in the *Equator*; or which is the ſame thing, the Aggregate of the Sun's Heat upon us while he deſcribes any two oppoſite Parallels, is greater than it would be if in thoſe two Days he deſcrib'd the *Equator*; whereas in the *Torrid Zone*, and even in the Temperate, almoſt as far as 45 Degrees of Latitude, the Sum of the Sun's Heat in Summer and Winter is leſs than it would be, were the *Axis* of the Earth perpendicular to the Plane of the *Ecliptick*; for the Demonſtration of which I refer the Reader to the Book it ſelf.

I think (proceeds he) this Conſideration cannot but lead us into a tranſcendent Admiration of the *divine Wiſdom*, which hath placed the Earth in ſuch a Poſture, as brings with it ſeveral Conveniences beyond what we can eaſily diſcover without Study and Application; and I make no queſtion, but if the reſt of the *Works of Nature* were well

well obſerv'd, we ſhould find ſeveral Advantages which accrue to us by their preſent Conſtitution, which are far beyond the Uſes of them that are yet diſcover'd; by which it will plainly appear, that God hath choſen better for us than we could have done for our ſelves.

If any Man ſhould object and ſay, it would be more convenient for the Inhabitants of the Earth if the Tropicks ſtood at a greater diſtance, and the Sun mov'd further northward and ſouthward, for ſo the North and South Parts would be reliev'd, and not expos'd to ſo extreme Cold, and thereby render'd uninhabitable, as now they are:

To this I anſwer, That this would be more inconvenient to the Inhabitants of the *Earth* in general, and yet would afford the *North* and *South* Parts but little more Comfort; for then as much as the Diſtances between the *Tropicks* were enlarg'd, ſo much would alſo the *Artick* and *Antartick* Circles be enlarg'd too; and ſo we here in *England*, and ſo on northerly, ſhould not have that grateful and uſeful Succeſſion of Day and Night, but proportionably to the Sun's coming towards us, ſo would our Days be of more than Twenty-four Hours Length; and according to his receſs in Winter, our Nights proportionable; which how great an Inconvenience it would be, is eaſily ſeen; whereas now the whole Latitude of the Earth, which hath at any time above twenty-four Hours Day and twenty-four Hours Night, is little and inconſiderable in compariſon of

of the whole Bulk, as lying near the *Poles*; and yet neither is that Part altogether unuſeful, for in the Waters there live Fiſhes, which other where are not obvious; ſo we know the chief *Whale-fiſhing* is in *Greenland*; yea, not only Fiſh, but great Variety of Water-Fowl, both whole and cloven-footed, frequent the Waters, and feed there, breeding alſo on the Cliffs by the Sea-ſide, as they do with us; the Figures and Deſcriptions of a great many whereof are given us by *Martin* in his Voyage to *Spitzberg*, or *Greenland*; and on the Land *Bears*, and *Foxes*, and *Deer*, in the moſt northerly Country that was ever yet touch'd; and doubtleſs, if we ſhall diſcover further to the very *North Pole*, we ſhall find all that Tract not to be vain, uſeleſs, or unoccupy'd.

Thirdly, The third and laſt thing I propos'd was, the Conſtitution and Conſiſtency of the Parts of the Earth. And firſt, admirable it is that the Waters ſhould be gather'd together into ſuch great *Conceptacula*, and the dry Land appear; and tho' we had not been aſſur'd thereof by divine Revelation, we could not in reaſon but have thought ſuch a Diviſion and Separation to have been the Work of Omnipotency, and infinite Wiſdom and Goodneſs; for in this Condition the Water nouriſhes and maintains innumerable Multitudes of various Kinds of Fiſhes, and the dry Land ſupports and feeds as great Variety of Plants and Animals, which have their firm Footing

Footing and Habitation; whereas had all been *Earth*, all the Species of *Fiſhes* had been loſt, and all thoſe Commodities which the Water affords us; or all *Water*, there had been no living for Plants, or terreſtrial Animals, or Man himſelf, and all the Beauty, Glory and Variety of this inferior World had been gone, nothing being to be ſeen, but one uniform dark Body of Water; or had all been mix'd and made up of Water and Earth into one Body of Mud or Mire, as one would think ſhould be moſt natural; for why ſuch a Separation as at preſent we find ſhould be made, no Account can be given but Providence; I ſay, had all this Globe been Mire or Mud, then could there have been no Poſſibility for any *Animals* at all to have liv'd, excepting ſome few, and thoſe very dull and inferior ones too. That therefore the *Earth* ſhould be made thus, and not only ſo, but with ſo great Variety of Parts, as Mountains, Plains, Vallies, Sand, Gravel, Lime, Stone, Clay, Marble, Argilla, *&c.* which are ſo delectable and pleaſant, and likewiſe ſo uſeful and convenient for the breeding and living of various Plants and Animals, ſome affecting Mountains, ſome Plains, ſome Vallies, ſome watery Places, ſome Shade, ſome Sun, ſome Clay, ſome Sand, ſome Gravel, *&c.* That the Earth ſhould be ſo figur'd as to have Mountains in the mid-land Parts, abounding with Springs of Water, pouring down Streams and Rivers for the Neceſſities and Conveniences of the Inhabitants

of

of the lower Countries, and that the Levels and Plains ſhould be form'd with ſo eaſy a Declivity as to caſt off the Water, and yet not render Travelling or Tillage very difficult or laborious; theſe things, I ſay, muſt needs be the Reſult of Counſel, Wiſdom, and Deſign; eſpecially when (as I ſaid before) not that way which ſeems more facil and obvious to Chance is choſen, but that which is more difficult and hard to be trac'd, when it is moſt convenient and proper for thoſe nobler Ends and Deſigns which were intended by its wiſe Creator and Governor. Add to all this, that the whole dry Land is, for the moſt part, cover'd over with a lovely Carpet of green Graſs, and other Herbs, of a Colour not only moſt grateful and agreeable, but moſt uſeful and ſalutary to the Eye; and this alſo deck'd and adorn'd with great Variety of Flowers of beautiful Colours and Figures, and of moſt pleaſant and fragrant Odours, for the Refreſhment of our Spirits and our innocent Delight; as alſo with beautiful Shrubs and ſtately Trees, affording us not only pleaſant and nouriſhing Fruits, many Liquors, Drugs, and good Medicines, but Timber, and Utenſils for all Sorts of Trades and the Conveniences of Man; out of many Thouſands of which we will only juſt name a few, leſt we ſhould be tedious and too bulky.

Firſt, The *Coco*, or *Coker-Nut* Tree, that ſupplies the *Indians* with almoſt whatever they ſtand

in need of, as Bread, Water, Wine, Vinegar, Brandy, Milk, Oil, Honey, Sugar, Needles, Thread, Linnen, Clothes, Cups, Spoons, Beesoms, Baskets, Paper, Masts for Ships, Sails, Cordage, Nails, Coverings for their Houses, *&c.* which may be seen at large in the many printed Relations of Voyages and Travels to the *East-Indies*, but most faithfully in the *Hortus Malabaricus*, publish'd by that immortal Patron of natural Learning, *Henry Van Reede Van Draakenstein*, who has had great Commands and Employs in the *Dutch* Colonies.

Secondly, The *Aloe Muricata*, *vel Aculeata*, which yields the *Americans* every thing their Necessities require, as Fences and Houses, Darts, Weapons, and other Arms, Shoes, Linnen, and Clothes, Needles and Thread, Wine and Honey, besides many Utensils; for all which *Hernandes*, *Garcililasso de la Vega*, and *Margrave*, may be consulted.

Thirdly, The *Bandura Cingalensium*, called by some the *Priapus Vegetabilis*, at the end of whose Leaves hang long Sacks or Bags, containing a pure limpid Water, of great Use to the *Natives* when they want Rain for Eight or Ten Months together.

A parallel Instance to this of the *Bandura*, my learned and worthy Friend Doctor *Sloane* affords

fords us in a Plant by him obſerved in the Iſland of *Jamaica*, and deſcribed by the Title of *Viſcum Caryophilloides Maximum flore tripetalo pallide luteo, ſemine filamentoſo*, which is commonly call'd, in that Iſland, *Wild Pine. Philoſoph. Tranſact. N°* 251. *Page* 114. I ſhall not tranſcribe the whole Deſcription, but only that Part of it which relates to this Particular: " From " the Root (which he had deſcribed before) ariſe " Leaves on every ſide, after the manner of " Leeks, or *Anana's*, whence the Name of " *Wild-Pine*, or *Aloes*, being folded or incloſed " one within another, each of which is two " Foot and an half long, and from a three Inch " Breadth at Beginning, or Baſe, ends in a " Point, having a very hollow or concave in- " ward Side, and a round or convex outward " one: So that by all their hollow Sides is made " within a very large Preſervatory Ciſtern or Ba- " ſin, fit to contain a pretty Quantity of Water, " which in the rainy Seaſon falls upon the ut- " moſt Parts of the ſpreading Leaves, which have " Chanels in them, conveying it down to the " Ciſtern where it is kept, as in a Bottle, the " Leaves, after they are ſwelled out like a bul- " bous Root to make the Bottle, bending inward " or coming again cloſe to the Stalk, by that " means hindring the Evaporation of the Wa- " ter, by the Heat of the Sun-Beams.

" In the mountainous, as well as the dry " low Woods, in Scarcity of Water, this Re- " ſervatory is not only neceſſary and ſufficient

" for the Nouriſhment of the Plant it ſelf, but " likewiſe is very uſeful to Men, Birds, and all " Sorts of Inſects, whither in Scarcity of Wa- " ter they come in Troops, and ſeldom go away " without Refreſhment.

" Captain *Dampier*, in his Voyages, *Vol.* II. " of *Campeche*, tells us, That theſe Baſins made " of the Leaves of the *Wild-Pine*, will hold a " Pint and half or a Quart of Water, and that " when they find theſe *Pines*, they ſtick their " Knives into the Leaves juſt above the Roots, " and that lets out the Water, which they catch " in their Hats, as (ſaith he) I have done many " times, to my great Relief.

Fourthly, The *Cinnamon-Tree* of *Ceylon*, in whoſe Parts there is a wonderful Diverſity: Out of the Root they get a Sort of *Camphire*, and its Oil; out of the Bark of the Trunk, the true Oil of *Cinnamon*; from the Leaves, an Oil like that of *Cloves*; out of the Fruit, a *Juniper* Oil, with a Mixture of thoſe of *Cinnamon* and *Cloves*; beſides, they boil the Berries into a Sort of Wax, out of which they make Candles, Plaiſters, Unguents. Here we may take Notice of the *Candle-Trees* of the *Weſt-Indies*, out of whoſe Fruit, boil'd to a thick fat Conſiſtence, are made very good Candles, many of which have been lately diſtributed by that moſt ingenious Merchant, Mr. *Charles Dubois*.

I

Fifthly,

Fifthly, The *Fountains*, or *Dropping-Trees*, in the Isles of *Ferro*, *St. Thomas*, and in *Guiney*, which serve the Inhabitants instead of Rain, and fresh Springs: My honoured Friend, Dr. *Tancred Robinson*, in a late Letter to me, is not of *Vossius*'s Opinion, that these Trees are of the *Farulaceous* Kind, because he observes, that by the Descriptions of Eye-witnesses, and by the dry'd Sample sent by *Paludanus* to the Duke of *Wirtenberg*, the Leaves are quite different from those of the *Ferula*'s, coming nearer to the *Seseli Ethiopicum Salicis vel Periclymeni folio:* Therefore the *Doctor* rather thinks them to be of the *Laurel*-kind, though he concludes here may be many different Sorts of these running Aqueous-Trees; because that *Phænomenon* does not depend upon, or proceed from any Peculiarity of the Plant, but rather from the Place and Situation; of which he writes more at large, in a Letter printed in another Discourse of mine.

Sixthly, and *Lastly*, We will only mention the Names of some other Vegetables, which, with Eighteen or Twenty Thousand more of that Kind, do manifest to Mankind the illustrious Bounty and Providence of the Almighty and Omniscient Creator, towards his undeserving Creatures; as the *Cotton-Trees*, the *Manyoc*, or *Cassava*; the *Potatoe*; the *Jesuit's-Bark Tree*; the *Poppy*; the *Rhubarb*; the *Scammony*;

mony; the *Jalap*; the *Coloquintida*; the *China*; *Sarsa*; the *Serpentaria Virginiana*, or *Snake-weed*; the *Nisi*, or *Genseg*; the *Numerose Balsam*, and *Gum-trees*; many of which are of late much illustrated by the great Industry and Skill of that most discerning Botanist, Dr. *Leonard Plukenet*. Of what great Use all these, and innumerable other Plants, are to Mankind in the several Parts of Life, few or none can be ignorant; besides the known Uses in Curing Diseases, in Feeding and Cloathing the Poor, in Building, in Dying: In all Mechanicks there may be as many more not yet discovered, and which may be reserved on purpose to exercise the Faculties bestowed on Man, to find out what is necessary, convenient, pleasant, or profitable to him.

To sum up all in brief: This *Terraqueous* Globe we know is made up of two Parts;

1. A thin and fluid.
2. A firm and consistent..

The former, called by the Name of *Water*; the latter, of *Earth*, or *Dry Land*. The *Land*, being the more dense and heavy Body, doth naturally descend beneath the Water, and occupy the lower Place; the Water ascends and floats above it. But we see that it is not thus: For the *Land*, though the more heavy, is forcibly and contrary to its Nature so elevated as to cast off the Water, and stand above it, be-

ing (as the Pſalmiſt phraſes it) *founded* upon or *above the Seas, and eſtabliſh'd above the Floods*, Pſal. xxiv. 2. and this in ſuch manner, that not only on one ſide of the Globe, but on all ſides, there were probably Continents and Iſlands, raiſed ſo equally as to counterbalance one another, the Water flowing between them, and filling the hollow and depreſſed Places; neither was the dry Land only raiſed up and made to appear, but ſome Parts (which we call Mountains) were highly elevated above others, and thoſe ſo diſpos'd and ſituated (as we have ſhewn) in the mid-land Parts, and in continu'd Chains running *Eaſt* and *Weſt*, as to render all the Earth habitable, a great Part whereof otherwiſe would not have been ſo; but the *Torrid Zone* muſt indeed have been ſuch a Place as the Ancients fancy'd it, unhabitable for Heat. Let us now conſider how much better it is that the dry Land ſhould be thus raiſed up, and the Globe divided almoſt equally between Earth and Water, than that all its Surface ſhould be one uniform and dark Body of Water; I ſay Water, becauſe that naturally occupies the ſuperior Place, and not Earth; for were it all Water, the whole Beauty of this inferior World were gone; there could be no ſuch pleaſant and delicious Proſpects as the Earth now affords us; no Diſtinction, and grateful Variety of Mountains and Hills, Plains and Vallies, Rivers and Pools, and Fountains; no ſhady Woods, ſtor'd with lofty and towring Trees for Timber, lowly and more ſpread ones for Shade and Fruit; no ami-

able Verdure of Herbs, beſpangled with an infinite Variety of ſpecious and fragrant Flowers; for thoſe Plants that grow at the bottom of the Sea, are for the moſt part of a dull, ſullen, and dirty Olive Colour, and bear no Flowers at all; inſtead of the elegant Shapes and Colours, the Sagacity and Docility of ingenious Beaſts and Birds, the muſical Voices and Accents of the aereal Choriſters, there had been nothing but mute, and ſtupid, and indocil Fiſhes, which ſeem to want the very Senſe of Diſcipline, as may be gather'd from that they are not vocal, and that there appear in them no Organs of hearing, it being alſo doubtful whether the Element they live in be capable of tranſmitting Sounds; the beſt Senſe they have, even their Sight, can be but dull and imperfect, the Element of Water being ſemi-opake, and reflecting a good part of the Beams of Light; the moſt noble and ingenious Creatures that live there, the Cetaceous Kind, being near a-kin to terreſtrial Animals, and breathing in the ſame Element, the open Air. Had, I ſay, all been Water, there had been no Place for ſuch a Creature as Man, as we ſee there is no ſuch there; there is no Buſineſs for him, no Subject to employ his Art and Faculties, and conſequently there could be no Effects of them; no ſuch Things as Houſes and Cities, and ſtately Edifices; as Gardens and Orchards, and Walks, and Labyrinths; as Corn-Fields and Vineyards, and the reſt of theſe Ornaments, wherewith the Wit

Wit and Induſtry of Man hath embeliſh'd the World.

Theſe are great things, and worthy the Care and Providence of the Creator; which whoſo conſidereth, and doth not diſcern and acknowledge, muſt needs be as ſtupid as the Earth he goes upon.

But becauſe Mountains have been look'd upon by ſome as Warts, and ſuperfluous Excreſcencies, of no Uſe or Benefit, nay, rather as Signs and Proofs that the preſent Earth is nothing elſe but a Heap of Rubbiſh and Ruins, I ſhall reduce and demonſtrate in Particulars the great Uſe, Benefit, and Neceſſity of them.

I. They are of eminent Uſe for the Production and Original of Springs and Rivers; without Hills and Mountains there could be no ſuch things, or at leaſt but very few, no more than we now find in plain and level Countries, that is, ſo few, that it was never my hap to ſee one; in Winter-time indeed we might have Torrents and Land-floods, and perhaps ſometimes great Inundations; but in Summer nothing but ſtagnating Water, reſerv'd in Pools and Ciſterns, or drawn up out of deep Wells; but as for a great Part of the Earth (all lying within or near the Tropicks) it would neither have Rivers, nor any Rain at all; we ſhould conſequently loſe all thoſe Conveniences and Advantages that Rivers afford

us, of Fishing, Navigation, Carriage, driving of Mills, Engines, and many others. This End of Mountains I find assign'd by Mr. *Edmund Hally*, a Man of great Sagacity and deep Insight into the Natures and Causes of Things, in a Discourse of his publish'd in the *Philosoph. Transactions*, Numb. 192. in these Words: *This, if we may allow final Causes* [*Hardiment*, the thing is clear, pronounce boldly, without any *Ifs* or *Ands*] *This seems to be one Design of the Hills, that their Ridges being plac'd through the midst of their Continents, might serve as it were for Alembicks, to distil fresh Water for the Use of Man and Beast; and their Heights to give a Descent of those Streams; to run gently, like so many Veins of the Microcosm, to be the more beneficial to the Creation.*

II. They are of great Use for the Generation, and convenient digging up of Metals and Minerals; which how necessary Instruments they are of Culture and Civility, I have before shewn; these we see are all digg'd out of Mountains, and I doubt whether there is or can be any Generation of them in perfectly plain and level Countries; but if there be, yet could not such Mines, without great Pains and Charges, if at all, be wrought; the Delfs would be so flown with Waters (it being impossible to make any *Addits* or *Soughs* to drain them) that no Gins or Machines could suffice to lay and keep them dry.

III. They

III. They are useful to Mankind in affording them convenient Places for Habitation, and Situations of Houses and Villages, serving as Skreens to keep off the cold and nipping Blasts of the *Northern* and *Easterly* Winds, and reflecting the benign and cherishing Sun-beams, and so rendring their Habitations both more comfortable and more chearly in Winter; and promoting the Growth of Herbs and Fruit-Trees, and the Maturation of their Fruits in Summer; besides casting off the Waters, they lay the Gardens, Yards, and Avenues to the Houses dry and clean, and so as well more salutary as more elegant; whereas Houses built in Plains, unless shaded with Trees, lie bleak, and expos'd to Wind and Weather, and all Winter are apt to be grievously annoy'd with Mire and Dirt.

IV. They are very ornamental to the Earth, affording pleasant and delightful Prospects, both, 1. To them that look downwards from them upon the subjacent Countries, as they must needs acknowledge who have been but on the Downs of *Sussex*, and enjoy'd that ravishing Prospect of the Sea on one hand, and the Country far and wide on the other. And, 2. To those that look upwards, and behold them from the Plains and low Grounds, which what a Refreshing and Pleasure it is to the Eye, they are best able to judge who have liv'd in the Isle of *Ely*, or other level

level Countries, extending on all Sides further than one can ken; or have been out far at Sea, where they can see nothing but Sky and Water. That the Mountains are pleasant Objects to behold, appears, in that the very Images of them, their Draughts and Landskips, are so much esteem'd.

V. They serve for the Production of great Variety of Herbs and Trees; for it is a true Observation, that Mountains do especially abound with different Species of Vegetables, because of the great Diversity of Soils that are found there, every *Vertex* or Eminency almost affording a new Kind. Now these Plants serve partly for the Food and Sustenance of such Animals as are proper to the Mountains, partly for medicinal Uses, the chief Physick Herbs and Roots, and the best in their Kinds, growing there; it being remarkable that the greatest and most luxuriant *Species* in most *Genera* of Plants are native of the Mountains; partly also for the Exercise and Diversion of such ingenious and industrious Persons as are delighted in searching out these natural Rarities, and observing the outward Form, Growth, Natures and Uses of each *Species*, and reflecting upon the Creator of them his due Praises and Benedictions.

VI. They serve for the Harbour, Entertainment, and Maintenance of various Animals, Birds, Beasts, and Insects, that breed, feed, and frequent

frequent there; for the higheſt Tops and Pikes of the *Alps* themſelves are not deſtitute of their Inhabitants; the *Ibex*, or *Stein-Buck*, the *Rupicapra* or *Chamois* among Quadrupeds; the *Lagopus* among Birds; and I my ſelf have obſerv'd beautiful *Papilio's*, and Store of other Inſects, upon the Tops of ſome of the *Alpine* Mountains; nay, the higheſt Ridges of many of thoſe Mountains ſerve for the Maintenance of Cattel for the Service of the Inhabitants of the Valleys; the Men there, leaving their Wives and younger Children below, do not without ſome difficulty clamber up the Acclivities, dragging their Kine with them, where they feed them, and milk them, and make Butter and Cheeſe, and do all the Dairy-Work, in ſuch ſorry Hovels and Sheds as they build there to inhabit in during the Summer Months; this I my ſelf have ſeen and obſerv'd in Mount *Jura*, not far from *Geneva*, which is high enough to retain Snow all the Winter.

The ſame they do alſo in the *Griſons* Country, which is one of the higheſt Parts of the *Alps*, travelling through which I did not ſet Foot off Snow for four Days Journey, at the latter End of *March*.

VII. Thoſe long Ridges and Chains of lofty and topping Mountains which run through the whole Continents *Eaſt* and *Weſt* (as I have elſe-

where

where obſerv'd) ſerve to ſtop the Evagation of the Vapours to the *North* and *South* in hot Countries, condenſing them, like Alembick Heads, into Water, and ſo by a kind of external Diſtillation giving Original to Springs and Rivers; and likewiſe by amaſſing, cooling, and conſtipating of them, turn them into Rain; by thoſe means rendring the fervid Regions of the *Torrid Zone* habitable.

This Diſcourſe concerning the Uſe of Mountains, I have made uſe of in another * Treatiſe; but becauſe it is proper to this Place, I have (with ſome Alterations and Enlargements) here repeated it.

* *The Diſſolution of the World.*

I had almoſt forgotten that Uſe they are of to Mankind, in ſerving for Boundaries and Defences to the Territories of Kingdoms and Commonwealths.

A ſecond Particular I have made choice of more exactly to ſurvey and conſider, is the Body of Man; wherein I ſhall endeavour to diſcover ſomething of the Wiſdom and Goodneſs of God: Firſt, by making ſome general Obſervations concerning the Body. Secondly, by running over and diſcourſing upon its principal Parts and Members.

1. Then,

1. Then, in general, I say, the Wisdom and Goodness of God appears in the *erect Posture* of the Body of Man, which is a Privilege and Advantage given to Man above other Animals; but tho' this be so, yet I would not have you think that all the Particulars I shall mention are proper only to the Body of Man, divers of them agreeing to many other Creatures. It is not my Business to consider only the Prerogatives of Man above other Animals, but the Endowments and Perfections which Nature hath conferr'd on his Body, tho' common to them with him. Of this *Erection* of the *Body* of Man the Ancients have taken notice, as a particular Gift and Favour of God,

Pronàq; cùm spectent Animalia cætera terram,
Os homini sublime dedit, cælumque tueri
Jussit, & erectos ad Sydera tollere vultus.
Ovid. Metam. 1.

And before him, *Tully* in his Second Book, *De Nat. Deorum*;

Ad hanc providentiam naturæ tàm diligentem tàmque solertem adjungi multa possunt, è quibus intelligatur quantæ res hominibus à Deo, quàmque eximiæ tributæ sunt, qui primùm eos humo excitatos, celsos & erectos constituit, ut Deorum cognitionem cælum intuentes capere possent. Sunt enim è terra homines, non ut incolæ atque habitatores, sed quasi

quaſi ſpectatores ſuperarum rerum atque cæleſtium, quarum ſpectaculum ad nullum aliud genus animantium pertinet.

Man being the only Creature in this ſublunary World made to contemplate Heaven, it was convenient that he ſhould have ſuch a Figure, or *Situs* of the Parts of his Body, that he might conveniently look upwards. But to ſay the Truth in this reſpect, of contemplating the Heavens, or looking upwards, I do not ſee what Advantage a Man hath by this Erection above other Animals, the Faces of moſt of them being more ſupine than ours, which are only perpendicular to the *Horizon*, whereas ſome of theirs ſtand reclining; but yet two or three other Advantages we have of this Erection, which I ſhall here mention.

Firſt, It is more commodious for the ſuſtaining of the Head, which being full of Brains, and very heavy (the Brain in Man being far larger, in proportion to the Bulk of his Body, than in any other Animal) would have been very painful and wearifom to carry, if the Neck had lain parallel or inclining to the Horizon.

Secondly, This Figure is moſt convenient for Proſpect, and looking about one; a Man may ſee further before him, which is no ſmall Advantage for avoiding Danger, and diſcovering whatever he ſearches after.

Thirdly,

Thirdly, The Conveniency of this Site of our Bodies will more clearly appear, if we conſider what a pitiful Condition we had been in, if we had been conſtantly neceſſitated to ſtand and walk upon all Four; Man being, by the Make of his Body, of all Quadrupeds (for now I muſt compare him with them) the moſt unfit for that kind of *Inceſſus*, as I ſhall ſhew anon; and beſides that, we ſhould have wanted, at leaſt in a great meaſure, the Uſe of our Hand, that invaluable Inſtrument, without which he had wanted moſt of thoſe Advantages we enjoy as reaſonable Creatures, as I ſhall more particularly demonſtrate afterwards.

But it may be perchance objected by ſome, that Nature did not intend this Erection of the Body, but that it is ſuperinduc'd and artificial; for that Children at firſt creep on all four, according to that of the Poet;

Mox Quadrupes, rituque tulit ſua membra ferarum. Ovid.

To which I anſwer, that there is ſo great an Inequality in the Length of our Legs and Arms, as would make it extreamly inconvenient, if not impoſſible for us to walk upon all four, and ſet us almoſt upon our Heads; and therefore we ſee that Children do not creep upon their Hands and Feet, but upon their Hands and Knees; ſo that

that it is plain that Nature intended us to walk as we do, and not upon all four.

2. I argue from the *Situs*, or Position of our Faces; for had we been to walk upon all four, we had been the most prone of all Animals, our Faces being parallel to the Horizon, and looking directly downwards.

3. The Greatness and Strength of the Muscles of the Thighs and Legs above those of the Arms, is a clear Indication that they were by Nature intended for a more difficult and laborious Action, even the moving and transferring the whole Body, and that Motion to be sometimes continu'd for a great while together.

As for that Argument taken from the contrary Flexure of the Joints of our Arms and Legs to that of Quadrupeds, as that our Knees bend forward, whereas the same Joint of their hind Legs bends backward; and that our Arms bend backward, whereas the Knees of their fore Legs bend forward; although the Observation be as old as *Aristotle*, because I think there is a Mistake in it, in not comparing the same Joints (for the first and uppermost Joint in a Quadruped's hind Legs bends forward as well as a Man's Knees, which answer to it, being the uppermost Joint of our Legs, and the like *mutatis mutandis* may be said of the Arms) I shall not insist upon it.

Another

Another Particular which may ſerve to demonſtrate that this erect Poſture of the Body of Man was intended and deſign'd by the wiſe and good Author of Nature, is the faſtning of the Cone of the *Pericardium* to the Midriff, an Account whereof I ſhall give the Reader out of the ingenious Dr. *Tyſon's Anatomy* of the *Orang-Outang*, or *Pigmie*, p. 49.

Veſalius (ſaith he) and others make it a Peculiarity to Man, that the *Pericardium*, or Bag that incloſes the Heart, ſhould be faſten'd to the *Diaphragm*. *Veſalius* tells us *(De Corporis Humani fabrica*, lib. 6. cap. 8.) *Cæterùm involucri mucro, & dextri ipſius lateris egregia portio Septi tranſverſi nerveo circulo validiſſimè amploque admodum ſpatio connaſcitur, quod Hominibus eſt peculiare. The Point of the* Pericardium, *and a very conſiderable Portion of its right Side, is moſt firmly faſten'd to the nervous Circle of the Midriff for a large Space, which is peculiar to Mankind.* So *Blancardius*, *Anat. Reformat.* cap. 2. p. 8. *Homo præ cæteris Animalibus hoc peculiare habet, quod ejus Pericardium Septi tranſverſi medio ſemper accreſcat, cùm idem in Quadrupedum genere liberum & aliquanto ſpatio ab ipſo remotum ſit: Man hath this peculiar to him, and different from other Animals, that his* Pericardium *doth always grow to the middle of the Midriff; whereas in the Quadruped Kind it is free, and remov'd ſome diſtance from it.*

The *Pericardium* in Man is therefore thus faſten'd, that in *Expiration* it might aſſiſt the *Diaſtole*

ſtole of the *Diaphragm*, for otherwiſe the Liver and Stomach being ſo weighty, they would draw it down too much towards the *Abdomen*, ſo that upon the Relaxation of its Fibres in its *Diaſtole* it would not aſcend ſufficiently into the *Thorax*, ſo as to cauſe a Subſidency of the Lungs, by leſſening the Cavity there. In *Quadrupeds* there is no need of this Adheſion of the *Pericardium* to the *Diaphragm*, for in them in *Expiration*, when the Fibres of the *Diaphragm* are relax'd, the weight of the *Viſcera* of the *Abdomen* will eaſily preſs the *Diaphragm* up into the Cavity of the *Thorax*, and ſo perform that Service; beſides, were the *Pericardium* faſten'd to the *Diaphragm* in *Quadrupeds*, it would hinder its *Syſtole* in *Inſpiration*, or its Deſcent downwards upon the Contraction of its *muſcular Fibres*, and the more, becauſe the *Diaphragm* being thus ty'd up, it could not then ſo freely force down the weight of the *Viſcera*, which are always preſſing upon it, and conſequently not ſufficiently dilate the Cavity of the *Thorax*, and therefore muſt hinder their *Inſpiration*. Thus we ſee how neceſſary it is that in *Man* the *Pericardium* ſhould be faſten'd to the *Diaphragm*, and in *Quadrupeds* how inconvenient it would be. *And ſince we find this difference between the Hearts of Brutes and Men in this Particular, how can we imagine but that it muſt needs be the Effect of Wiſdom and Deſign, and that Man was intended by Nature to walk erect, and not upon all four, as Quadrupeds do?*

I

II. The

II. The Body of Man may thence be prov'd to be the Effect of Wisdom, because there is nothing in it deficient, nothing superfluous, nothing but hath its End and Use. So true are those Maxims we have already made use of: *Natura nihil facit frustra*, and *Natura non abundat in superfluis, nec deficit in necessariis*, no Part that we can well spare. *The Eye cannot say to the Hand, I have no need of thee; nor the Head to the Feet, I have no need of you*, 1 Cor. xii. 21. that I may usurp the Apostle's Similitude.

The Belly cannot quarrel with the Members, nor they with the Belly for her seeming Sloth; as they provide for Meat for her, so she concocts and distributes it to them; only it may be doubted to what Use the *Paps* in Men should serve. I answer, partly for Ornament, partly for a kind of Conformity between the Sexes, and partly to defend and cherish the Heart; in some they contain Milk, as in a *Danish* Family we read of in *Bartholine's Anatomical Observations*; however, it follows not that they or any other Parts of the Body are useless because we are ignorant.

I have lately met with a Story in Signior *Paulo Boccone's natural Observations*, printed at *Bologna* in *Italy* 1684, well attested, concerning a Countryman call'd *Billardino di Billo*, living in a Village belonging to the City of *Nocera* in *Umbria*, call'd *Somareggio*, whose Wife dying, and leaving a young Infant, he nourish'd it with his own Milk. This Man, either because in the small

Village where he liv'd there was not a wet Nurſe to be had, or becauſe he was not able to hire one, took the Child, and applying it to his own Boſom, and putting the Nipples of his Breaſts into its Mouth, invited it to ſuck, which the Infant did, and after divers times drawing, fetch'd ſome Milk; whereat the Father encourag'd, continu'd to apply it, and ſo after a while it brought down the Milk ſo plentifully as to nouriſh it for many Months, till it was fit to be wean'd. Hereupon my Author, having prov'd by ſufficient Authority of able Anatomiſts, ſuch as *Franciſcus Maria Florentinus*, and *Marcellus Malpighius*, that the Paps of Men have the ſame Structure and the ſame Veſſels with thoſe of Women, concludes, that Nature hath not given Paps to Men either to no purpoſe, or for meer Ornament, but, if need requires, to ſupply the Defect of the Female, and give Suck to the Young.

Had we been born with a large Wen upon our Faces, or a *Bavarian* Poke under our Chins, or a great Bunch upon our Backs like *Camels*, or any the like ſuperfluous Excreſcency, which ſhould be not only uſeleſs but troubleſome, not only ſtand us in no ſtead, but alſo be ill-favour'd to behold and burdenſome to carry about, then we might have had ſome Pretence to doubt whether an intelligent and bountiful Creator had been our Architect; for had the Body been made by Chance, it muſt in all likelihood have had many of theſe ſuperfluous and unneceſſary Parts.

But now seeing there is none of our Members but hath its Place and Use, none that we could spare, or conveniently live without, were it but those we account Excrements, the Hair of our Heads, or the Nails on our Fingers ends, we must needs be mad or sottish, if we can conceive any other than that an infinitely good and wise God was our Author and Former.

III. We may fetch an Argument of the Wisdom and Providence of God from the convenient Situation and Disposition of the Parts and Members of our Bodies; they are seated most conveniently for Use, for Ornament, and for mutual Assistance.

First, For Use. So we see the Senses, of such eminent Use for our well-being, situate in the Head, as Sentinels in a Watch-Tower, to receive and convey to the Soul the Impressions of external Objects. *Sensus autem interpretes ac nuntii rerum in capite tanquam in arce mirificè ad usus necessarios & facti & collocati sunt.* Cic. de Nat. Deorum. The Eye can more easily see Things at a distance, the Ear receive Sounds from afar; how could the Eye have been better plac'd, either for Beauty and Ornament, or for the Guidance and Direction of the whole Body? As *Cicero* proceeds well, *Nam Oculi tanquam speculatores altissimum locum obtinent, ex quo plurima conspicientes funguntur suo munere: Et Aures quæ so-*

num recipere debent, qui naturâ in ſublime fertur, rectè in altis corporum partibus collocatæ ſunt; itemque Nares, eò quòd omnis odor ad ſuperiora fertur, rectè ſurſum ſunt. For the Eyes, like Sentinels, occupy the higheſt Place, from whence ſeeing many things, they perform their Functions; and the Ears, which are made for the Reception of Sounds, which naturally are carry'd upwards, are rightly plac'd in the uppermoſt Parts of the Body; alſo the Noſtrils, becauſe all Odours aſcend, are fitly ſituate in the ſuperior Parts. I might inſtance in the other Members; how could the Hands have been more conveniently plac'd for all Sorts of Exerciſes and Works, and for the Guard and Security of the Head and principal Parts? the Heart, to diſpenſe Life and Heat to the whole Body, *viz.* near the Center? and yet becauſe it is harder for the Blood to aſcend than deſcend, ſomewhat nearer the Head? It is alſo obſervable, that the Sinks of the Body are remov'd as far from the Noſe and Eyes as may be, which *Cicero* takes notice of in the fore-mention'd Place: *Ut in Ædificis Architecti avertunt ab Oculis & Naribus Dominorum ea quæ profluentia neceſſariò eſſent tetri aliquid habitura, ſic natura res ſimiles procul amandavit à ſenſibus.*

Secondly, For Ornament: What could have been better contriv'd, than that thoſe Members which are Pairs, ſhould ſtand by one another in equal Altitude, and anſwer on each Side one to another? And,

Thirdly,

Thirdly, For mutual Assistance. We have before shew'd how the Eye stands most conveniently for guiding the Hand, and the Hand for defending the Eye; and the like might be said of the other Parts, they are so situate as to afford Direction and Help one to another; this will appear more clearly, if we imagine any of the Members situate in contrary Places or Positions. Had a Man's Arms been fitted only to bend backwards behind him, or his Legs only to move backwards, what Direction could his Eyes then have afforded him in working or walking? or how could he then have fed himself? nay, had one Arm been made to bend forward, and the other directly backward, we had then lost half the Use of them, since they could not have assisted one the other in any Action. Take the Eyes, or any other of the Organs of Sense, and see if you can find any so convenient a Seat for them in the whole Body as that they now possess.

IV. From the ample Provision that is made for the Defence and Security of the principal Parts; those are, 1. The *Heart*, which is the Fountain of Life and Vegetation, *Officina Spirituum vitalium*, *Principium & Fons Caloris nativi*, *Lucerna humidi radicalis*; and that I may speak with the Chymists, *Ipse Sol Microcosmi*, *the very Sun of the Microcosm*, or little World, in which is contain'd that vital Flame, or heavenly Fire, which *Prometheus* is fabled to have stole from

Jupiter; or, as *Aristotle* phrases it, that Διάλογον τῷ τῶν ἀπλανῶν στοιχείῳ. *Divinum quid respondens Elemento Stellarum.* This for more Security is situate in the Center of the Trunk of the Body, cover'd first with its own Membrane, call'd *Pericardium*, lodg'd within the soft Bed of the Lungs, encompass'd round with a double Fence, (1.) Of firm Bones or Ribs, to bear off Blows: (2.) Of thick Muscles and Skins, besides the Arms conveniently plac'd, to fence off any Violence at a distance, before it can approach to hurt it. 2. The *Brain*, which is the Principal of all Sense and Motion, the Fountain of the animal Spirits, the chief Seat and Palace Royal of the Soul, upon whose Security depends whatever Privilege belongs to us as sensitive or rational Creatures; this, I say, being the prime and immediate Organ of the Soul, from the right Constitution whereof proceeds the Quickness of Apprehension, Acuteness of Wit, Solidity of Judgment, Method and Order of Invention, Strength and Power of Memory (which if once weaken'd and disorder'd, there follows nothing but Confusion and Disturbance in our Apprehensions, Thoughts and Judgment) is environ'd round about with such a potent Defence, that it must be a mighty Force indeed that is able to injure it.

1. A Skull, so hard, thick and tough, that it is almost as easy to split a Helmet of Iron as to make a Fracture in it. 2. This is cover'd with Skin and Hair, which serve to keep it warm, being

ing naturally a very cold Part, and alſo to quench and diſſipate the force of any Stroke that ſhall be dealt it, and retund the Edge of any Weapon. 3. And yet more than all this, there is ſtill a thick and tough Membrane, which hangs looſer about it, and doth not ſo cloſely embrace it (that they call *Dura Mater)* and in caſe the Skull happens to be broken, doth often preſerve it from Injury and Diminution. And laſtly, a thin and fine Membrane, ſtrait, and cloſely adhering, to keep it from quaſhing and ſhaking. The many Pairs of Nerves proceeding from it, and afterwards diſtributing and branching themſelves to all the Parts of the Body, either for Nutrition or Motion, are wonderful to behold in prepar'd Bodies, and even in the Schemes and Figures of Dr. *Willis* and *Vieuſſens*.

I might inſtance (3.) in the *Lungs*, which are ſo uſeful to us as to Life and Senſe, that the Vulgar think our Breath is our very Life, and that we breathe out our Souls from thence; ſuitable to which Notion both *Anima* and *Spiritus* in *Latin*, and πνεῦμα in *Greek*, are deriv'd from Words that ſignify Breath and Wind; and *efflare*, or *exhalare Animam*, ſignify to die. And the old *Romans* uſed to apply Mouth to Mouth and receive the laſt Gaſps of their dying Friends, as if their Souls had come out that way; from hence perhaps might firſt ſpring that Opinion of the Vehicles of Spirits; the Vulgar, as I hinted before, conceiving that the Breath was, if not the Soul it ſelf, yet that wherein it was wafted and carry'd

carry'd away. These *Lungs*, I say, are, for their better Security and Defence, shut up in the same Cavity with the Heart.

V. In the abundant Provision that is made against evil Accidents and Inconveniences. And the Liberality of Nature as to this Particular appears, 1. In that she hath given many Members (which are of eminent Use) by Pairs, as two Eyes, two Ears, two Nostrils, two Hands, two Feet, two Breasts [*Mammæ*] two Reins; that so, if by any cross or unhappy Accident one should be disabled or render'd useless, the other might serve us tolerably well; whereas had a Man but one Hand or one Eye, &c. if that were gone, all were gone, and we left in an evil Case. See then and acknowledge the Benignity of the Deity, who hath bestow'd upon us two Hands and two Eyes, and other the like Parts, not only for our Necessity but Conveniency so long as we enjoy them, and for our Security in case any Mischance deprive us of one of them. 2. In that all the Vessels of the Body have many Ramifications, which particular Branches, tho' they serve mainly for one Member or Muscle, yet send forth some Twigs to the neighbouring Muscles, and so interchangeably the Branches that serve these send to them; so that if one Branch chance to be cut off or obstructed, its Defect may in some measure be supply'd by the Twigs that come from the neighbouring Vessels. 3. In that she hath provided so many ways to evacuate what might be hurtful

hurtful to us, or breed Diſeaſes in our Bodies; if any thing oppreſs the Head, it hath a Power to free it ſelf by ſneezing; if any thing fall into the Lungs, or if any Humour be diſcharg'd upon them, they have a Faculty of clearing themſelves and caſting it up by coughing; if any thing clog or burden the Stomach, it hath an Ability of contracting itſelf and throwing it up by Vomit. Beſides theſe ways of Evacuation, there are Siege, Urine, Sweating, *Hæmorrhaiges* from the Noſe, and *hæmorrhodial* Veins, Fluxes of Rheum. Now the reaſon why Nature hath provided ſo many ways of Evacuation is, becauſe of the different Humours that are to be voided or caſt out; when therefore there is a Secretion made of any noxious Humour, it is carry'd off by that Emunctory, whoſe Pores are fitted to receive and tranſmit the minute Parts of it; if at leaſt this Separation be made by Percolation, as we will now ſuppoſe, but not aſſert, yet I doubt not but the ſame Humour may be caſt off by divers Emunctories, as is clear in Urine and Sweat, which are for the main the ſame Humour carry'd off ſeveral ways.

To this Head of Proviſion againſt Inconveniences, I ſhall add an Obſervation or two concerning Sleep.

1. Sleep being neceſſary to Man and other Animals for their Refreſhment, and for the Reparation of that great Expence of Spirits which is made in the Day-time by the conſtant Exerciſe of

of the Senſes and Motions of the Muſcles, that it might eaſe and refreſh us indeed, Nature hath provided, that tho' we lie long upon one Side, we ſhould have no Senſe of Pain or Uneaſineſs during our Reſt, no, nor when we awake; whereas in reaſon one would think, that the whole Weight of the Body preſſing the Muſcles and Bones on which we lie, ſhould be very burdenſome and uneaſy, and create a grievous Senſe of Pain; and we find by Experience that it doth ſo when we lie long awake in the Night, we being not able (eſpecially if never ſo little indiſpoſed) to reſt one Quarter of an Hour in the ſame Poſture, without ſhifting of Sides, or at leaſt etching this way and that way, more or leſs. How this may be effected, is a great Queſtion. To me it ſeems moſt probable that it is done by an Inflation of the Muſcles, whereby they become both ſoft, and yet renitent, like ſo many Pillows, diſſipating the Force of the Preſſure, and ſo preventing or taking away the Senſe of Pain. That the Muſcles are in this manner inflated in time of Reſt, appears to the very Eye in the Faces of Children, and may be prov'd from that, when we reſt in our Cloaths we are fain to looſen our Garters, Shoe-ſtrings, and other Ligatures, to give the Spirits free Paſſage, elſe we ſhall experience Pain and Uneaſineſs in thoſe Parts, which when we are waking we find not.

The

The reaſon of this *Phænomenon*, *viz.* that ἀναλγησία, or want of Pain we experience in Sleep, during and after a long *decubitus* on one Side, Dr. *Liſter* in his *Journey to* Paris, *p.* 113. and Dr. *Jones* in his Treatiſe of *The Myſteries of Opium reveal'd*, attribute to the Relaxation of the Nerves and Muſcles in time of Sleep; and the Senſe of Pain and Uneaſineſs when we lie awake, to the Tenſion of them during that time: This I do not deny, but yet I think the Reaſon I have aſſign'd hath a great Intereſt in that Reſt and Eaſineſs we enjoy when aſleep.

2. Becauſe Sleep is inconſiſtent with the Senſe of Pain, therefore during Reſt, thoſe Nerves which convey that Motion to the Brain, which excites in the Soul a Senſe of Pain, are obſtructed; this I my ſelf have had frequent Experience of ſince I have been troubled with Sores on my Legs; upon ſudden awaking finding my ſelf at perfect Eaſe, and void of all Senſe of Pain for a Minute's time or more, the Pain then by degrees returning; which I could attribute to nothing but the diſſipating that Vapour, or whatever elſe it were, which obſtructed the Nerves, and giving the dolorifick Motion free Paſſage again.

Upon ſecond Thoughts, and reading what Dr. *Liſter* and Dr. *Jones* have written concerning this Subject, I rather incline to believe, that the Motion cauſing a Senſe of Pain, is convey'd to the

the Brain by the Nerves themſelves in Tenſion, as we ſee in Cords, any the leaſt touch at one end, paſſes ſpeedily to the other when they are ſtretch'd, which it doth not when they are relax'd, and not by the Spirits paſſing thro' them; and on the other ſide, the Inſenſibleneſs of Pain proceeds rather from the Relaxation of the Nerves than their Obſtruction; but yet this Tenſion of the Nerves and Muſcles is owing to the Spirits flowing down into them and diſtending them.

VI. From the Conſtancy that is obſerv'd in the Number, Figure, Place, and Make of all the principal Parts, and from the Variety in the leſs. Man is always mending and altering his Works, but Nature obſerves the ſame Tenor, becauſe her Works are ſo perfect, that there is no place for Amendments, nothing that can be reprehended; the moſt ſagacious Men in ſo many Ages have not been able to find any Flaw in theſe divinely contriv'd and form'd Machines, *no Blot or Error in this great Volume of the World, as if any thing had been an imperfect Eſſay at the firſt* (to uſe the Biſhop of *Cheſter*'s Words) nothing that can be alter'd for the better, nothing but if it were alter'd would be marr'd; this could not have been had Man's Body been the Work of Chance, and not Council and Providence: Why ſhould there be conſtantly the ſame Parts? why ſhould they retain conſtantly the ſame Places? why ſhould they be endu'd with the ſame Shape and Figure? Nothing ſo contrary as Conſtancy and Chance.

Should

Should I see a Man throw the same Number a thousand times together upon but three Dice, could you persuade me that this were accidental, and that there was no necessary Cause of it? How much more incredible then is it, that Constancy in such a Variety, such a Multiplicity of Parts, should be the Result of Chance? Neither yet can these Works be the Effects of Necessity or Fate, for then there would be the same Constancy observ'd in the smaller as well as the larger Parts and Vessels; whereas there we see Nature doth *ludere*, as it were sport it self, the minute Ramifications of all the Vessels, Veins, Arteries, and Nerves, infinitely varying in Individuals of the same Species, so that they are not in any two alike.

VII. The great Wisdom of the divine Creator appears, in that there is Pleasure annex'd to those Actions that are necessary for the Support and Preservation of the *Individuum*, and the Continuation and Propagation of the *Species*; and not only so, but Pain to the Neglect or Forbearance of them. For the Support of the Person, it hath annex'd Pleasure to eating and drinking, which else, out of Laziness or Multiplicity of Business, a Man would be apt to neglect, or sometimes forget; indeed to be oblig'd to chew and swallow Meat daily for two Hours Space, and to find no Relish or Pleasure in it, would be one of the most burdensom and ungrateful Tasks of a Man's whole Life; but because this Action is absolutely necessary,

neceſſary, for abundant Security Nature hath inſerted in us a painful Senſe of Hunger, to put us in mind of it; and to reward our Performance hath adjoin'd Pleaſure to it; and as for the Continuation of Kind, I need not tell you that the Enjoyments which attend thoſe Actions are the higheſt Gratifications of Senſe.

VIII. The wonderful Art and Providence of the Contriver and Former of our Bodies, appears in the Multitude of Intentions he muſt have in the Formation of the ſeveral Parts, or the Qualifications they require to fit them for their ſeveral Uſes. * *Galen* in his Book *de Formatione Fœtus*, takes notice, "That there are in a human "Body above Six-hundred ſeveral "Muſcles, and there are at leaſt Ten ſeveral In- "tentions or due Qualifications to be obſerv'd "in each of theſe; proper Figure, juſt Mag- "nitude, right Diſpoſition of its ſeveral Ends, "upper and lower, Poſition of the whole, the "Inſertion of its proper Nerves, Veins, and "Arteries, which are each of them to be du- "ly placed; ſo that about the Muſcles alone "no leſs than Six thouſand ſeveral Ends or "Aims are to be attended to. The Bones are "reckon'd to be 284. The diſtinct Scopes or "Intentions in each of theſe are above 40; in "all about 100000. And thus it is in ſome "Proportion with all the other Parts, the "*Skin*, *Ligaments*, *Veſſels*, *Glandules*, *Humours*:

* *Biſhop of* Cheſter's Nat. Relig. *lib.* 1. *c.* 6.

"But

" But more eſpecially with the ſeveral Members " of the Body, which do, in regard of the great " Variety and Multitude of thoſe ſeveral Inten- " tions requir'd to them, very much exceed the " *homogeneous* Parts; and the failing in any one " of theſe would cauſe Irregularity in the Body, " and in many of them ſuch as would be very " notorious." Now to imagine that ſuch a Machine, compos'd of ſo many Parts, to the right Form, Order and Motion whereof ſuch an infinite Number of Intentions are requir'd, could be made without the Contrivance of ſome wiſe Agent, muſt needs be irrational in the higheſt degree.

This wonderful Mechaniſm of human Bodies, next to viewing the Life, may be ſeen at large in the excellent Figures of *Spigelius* and *Bidloo*, their Situation, Order, Connexion, and manner of ſeparating them, in *Lyſerus* his *Cult. Anatom.* The almoſt infinite Ramifications and Inoſculations of all the ſeveral Sorts of Veſſels, the Structures of the Glands, and other Organs, may eaſily be detected by Glaſſes, and trac'd by blowing in of Air and drying them, or by injecting thro' peculiar Syringes melted Wax or Quickſilver, the Operations whereof may be learn'd out of *Swammerdam*, *Caſpar Bartholine*, and *Antonio Nuck.*

IX. Another Argument of Wiſdom and Deſign in Contrivance of the Body of Man and other Animals, is the fitting of ſome Parts to divers Offices and Uſes, whereby Nature doth (as

the Proverb is) *Unâ fideliâ duos parietes dealbare, ſtop two Gaps with one Buſh*; ſo (for inſtance) the *Tongue* ſerves not only for taſting, but alſo to aſſiſt the Maſtication of the Meat and Deglutition, by turning it about, and managing it in the Mouth, to gather up the Food, in Man by licking; in the Dog and Cat-Kind by lapping; in Kine by plucking up the Graſs; particularly in Man it is of admirable Uſe for the Formation of Words and ſpeaking.

The *Diaphragm*, and Muſcles of the *Abdomen*, or lower Belly, are of uſe not only for Reſpiration, but alſo for compreſſing the Inteſtines, and forcing the Chyle into the lacteal Veins, and likewiſe out of the ſaid Veins into the *thoracick* Channel; and here (to note that by the way) appears the uſe of a common *Receptacle* of Chyle, that by the Motion of the Muſcles of Reſpiration it being preſs'd upon, the Chyle might with more Facility be impell'd into the fore-mention'd Duct; beſides, this Action of Reſpiration and Motion of the ſaid *Diaphragm* and Muſcles, may ſerve alſo for the Comminution and Concoction of the Meat in the Stomach (as ſome, not without reaſon, think) by their conſtant Agitation and Motion upwards and downwards, reſembling the pounding or braying of Materials in a Mortar.

And to inſtance in no more, the muſcular Contraction and Pulſe of the Heart ſerves not only for the Circulation of the Blood, but alſo for the more

more perfect Mixture of its Parts, preserving its due Crasis and Fluidity, and incorporating the Chyle, and other Juices it receives, with it.

X. The Wisdom and Goodness too of the divine Former of our Bodies, appears in the Nourishment of them; for that Food which is of a wholsome Juice, and proper to nourish and preserve them in a healthful State, is both pleasant to the Taste and grateful and agreeable to the Stomach, and continues to be so till our Hunger and Thirst be well appeas'd, and then begins to be less pleasant, and at last even nauseous and loathsome. *The full Stomach loaths the Honey-Comb.*

On the other side, that which is unwholsome and unfit for Nourishment, or destructive of Health, is also unpleasant to the Taste and ungrateful and disagreeable to the Stomach, and that more or less, according as it is more or less improper or noxious; and though there be some Sorts of Food less pleasant to the Taste, which by use may be render'd grateful, yet to Persons that are in health, and in no necessity of using such Viands, I think it were better to abstain from them, and follow Nature, in eating such things as are agreeable to their Palate and Stomach; for such unpleasant Diet must needs alter the Temper of the Body before it can become acceptable, and doubtless for the worse.

I might add hereto, that even Pain, which is the moſt grievous and afflictive thing that we are ſenſible of, is of great Uſe to us. God hath annex'd a Senſe of Pain to all Diſeaſes and Harms of the Body, inward and outward (and there is no Pain but proceeds from ſome Harm or Diſeaſe) to be an effectual Spur to excite and quicken us to ſeek for ſpeedy Help or Remedy; and hath ſo order'd it, that as the Diſeaſe heals, ſo the Pain abates. Neither doth Pain provoke us only to ſeek Eaſe and Relief when we labour under it, but alſo makes us careful to avoid for the future all ſuch things as are productive of it; that is, ſuch things as are hurtful to our Bodies, and deſtructive of the Health and Well-being of them, which alſo are for the moſt part prohibited by God, and ſo ſinful and injurious to our Souls. So we ſee what Care the divine Providence hath taken, and what effectual Means it hath us'd for the healing of our Diſeaſes, and the Maintenance and Preſervation of our Health. This is the true reaſon of our Pain; howbeit, I will not deny but that God doth ſometimes himſelf immediately inflict Diſeaſes, even upon his own Children, for many good Conſiderations, which I ſhall not here enumerate; neither ſhall I mention the Uſes that Parents and Maſters make of it, for the correcting their Children and Servants; or Magiſtrates, for the puniſhing of Malefactors, they being beyond my Scope; only I cannot but take notice, that it is a πολύχρηστον, a thing of manifold Uſes, and neceſſary for the Govern-

Government both of Commonwealths and Families.

XI. Some fetch an Argument of Providence from the Variety of Lineaments in the Faces of Men, which is such, that there are not two Faces in the World absolutely alike; which is somewhat strange, since all the Parts are *in Specie* the same. Were Nature a blind Architect, I see not but the Faces of some Men might be as like as Eggs laid by the same Hen, or Bullets cast in the same Mould, or Drops of Water out of the same Bucket. This Particular I find taken notice of by *Pliny* in his Seventh Book, *cap.* 1. in these Words: *Jam in facie vultuque nostro, cum sint decem aut paulò plura membra, nullas duas in tot millibus hominum indiscretas effigies existere, quod Ars nulla in paucis numero præstet affectando.* To which, among other things, he thus prefaces: *Naturæ verò rerum vis atque majestas in omnibus momentis fide caret.*

Tho' this at first may seem to be a Matter of small moment, yet, if duly consider'd, it will appear to be of mighty Importance in all human Affairs; for should there be an undiscernable Similitude between divers Men, what Confusion and Disturbance would necessarily follow? What Uncertainty in all Sales and Conveyances, in all Bargains and Contracts? What Frauds and Cheats, and suborning of Witnesses? What a Subversion of all Trade and Commerce? What hazard in all judicial Proceedings, in all Assaults

and Batteries, in all Murders and Assassinations? In Thefts and Robberies what Security would there be to Malefactors? who could swear that such and such were the Persons that committed the Facts, tho' they saw them never so clearly? Many other Inconveniences might be instanc'd in; so that we see this is no contemptible Argument of the Wisdom and Goodness of God.

Neither is the difference of Voices less considerable, for the distinguishing of Sexes and particular Persons, and Individuals of all Animals, than that of Faces; as Dr. *Cockburn* makes out, *Essay*, &c. *Part* II. *Pag.* 68. &c. Nay, in some Cases more; for hereby Persons in the dark and those that are blind may know and distinguish one another, which is of great Importance to them, for otherwise they might be most grosly cheated and abus'd.

Farther we may add out of the same Author, *p.* 71. "And to no other Cause [than the wise "Providence of God] can be referr'd the no less "strange Diversity of Hand-writings. Common "Experience shews, that though Hundreds and "Thousands were taught by one Master, and "one and the same Form of Writing, yet they "should all write differently: Whether Men "write *Court* or *Roman* Hand, or any other, "there is something peculiar in every one's Wri-"ting which distinguisheth it. Some indeed can "counterfeit another's Character and Subscrip-"tion, but the Instances are rare, nor is it done "without Pains and Trouble; nay, the most

"Expert

" Expert and Skilful cannot write much ſo ex-
" actly like as that it cannot be known whether
" it be genuine or counterfeit; and if the Pro-
" vidence of God did not ſo order it, what Cheats
" and Forgeries too would daily be committed,
" which would not only juſtle private Men out
" of their Rights, but alſo unhinge States and
" Governments, and turn all into Confuſion?
" The Diverſity of Hand-writings is of mighty
" great Uſe to the Peace of the World; it pre-
" vents Frauds, and ſecures Mens Property; it
" obligeth the Living and Preſent to Honeſty and
" Faithfulneſs; it importeth the Mind of the
" Abſent, and ſheweth the Will of the Dead,
" which ought to be ſacredly obſerv'd: And
" what is ſo very uſeful, is not the Effect of any
" human Concert; Men did not of themſelves
" agree to it, they are only carry'd to it by the
" ſecret Providence of God, who underſtandeth
" and mindeth what is for the Good and Intereſt
" of Mankind in general, and of every particu-
" lar Perſon.

Add farther to all this, that whereas there are ſeveral Parts peculiar to Brutes which are wanting in Man; as for Example, the ſeventh, or ſuſpenſory Muſcle of the Eye, the nictating Membrane, the ſtrong *Aponeuroſes* on the ſides of the Neck, call'd by ſome *Packwax*, it is very remarkable that theſe Parts are of eminent and conſtant Uſe to them, as I ſhall particularly ſhew hereafter, but to Man would have been altogether uſeleſs and ſuperfluous.

I have done with my general Obſervations, I proceed now more accurately and minutely to conſider ſome particular Parts or Members of the Body; and firſt, the *Head*, becauſe it was to contain a large Brain, made of the moſt capacious Figure, as near as could be to a ſpherical; upon this grows the Hair, which, tho' it be eſteem'd an Excrement, is of great Uſe (as I ſhew'd before) to cheriſh and keep warm the Brain, and to quench the Force of any Stroke, that might otherwiſe endanger the Skull; it ſerves alſo to diſburden the Brain of a great deal of ſuperfluous Moiſture, wherewith it abounds.

I find it remark'd by *Machetti*, a famous Anatomiſt in *Padua*, that the Cauſe of Baldneſs in Men is the dryneſs of the Brain, and its ſhrinking from the *Cranium*, or Skull; he having obſerv'd, that in bald Perſons, under the bald Part there was always a Vacuity or empty Space between the Skull and the Brain: and laſtly, to name no more, it ſerves alſo for a graceful Ornament to the Face, which our preſent Age is ſenſible enough of, beſtowing ſo much Money upon falſe Hair and Perriwigs.

Secondly, Another Member which I ſhall more particularly treat of, is the *Eye*, a Part ſo artificially compos'd and commodiouſly ſituate, as nothing can be contriv'd better for Uſe, Ornament, or Security; nothing to Advantage added thereto or alter'd therein. Of the Beauty of the Eye I ſhall ſay little, leaving that to Poets and Orators;

that

that it is a very pleaſant and lovely Object to behold, if we conſider the Figure, Colours, and Splendor of it, is the leaſt that I can ſay. The Soul, as it is more immediately and ſtrongly moved and affected by this Part than any other, ſo doth it manifeſt all its Paſſions and Perturbations by this. As the Eyes are the Windows to let in the *Species* of all exterior Objects into the dark Cells of the Brain for the Information of the Soul, ſo are they flaming Torches to reveal to thoſe abroad how the Soul within is moved or affected. Theſe Repreſentations made by the Impreſſions of external Objects upon the Eye are the moſt clear, lively, and diſtinct of any others. Now to this Uſe and Purpoſe of informing us what is abroad round about us in this aſpectable World, we ſhall find this Structure and Mechaniſm of the Eye, and every Part thereof, ſo well fitted and adapted, as not the leaſt Curioſity can be added; for firſt of all, the Humours and Tunicles are purely tranſparent, to let in the Light and Colours unfoil'd and unſophiſticated by any inward Tincture. It is uſually ſaid by the *Peripateticks*, that the cryſtalline Humour of the Eye (which they eneptly fancy'd to be the immediate Organ of Viſion, wherein all the Species of external Objects were terminated) is without all Colour, becauſe its Office was to diſcern all Colours, or at leaſt to receive the Species of ſeveral Colours, and convey them to the common Senſe. Now if it ſelf had been colour'd, it would have tranſmitted all viſible Objects tinctur'd with the

ſame

ſame Colour; as we ſee whatever is beheld thro' a colour'd Glaſs, appears of the ſame Colour with the Glaſs; and to thoſe that have the Jaundice, or the like Suffuſion of Eyes, Objects appear of that ſame Colour wherewith their Eyes are infected; this, they ſay, is in a great meaſure true, altho' they are much miſtaken about the Organ and Manner of Viſion, and the Uſes of the Humours and Membranes of the Eye. Two Reaſons therefore may be aſſign'd why all the Membranes and Humours of the Eye are perfectly pellucid, and void of Colour: *Firſt*, For the Clearneſs. *Secondly*, For the Diſtinctneſs of Viſion.

Firſt, The Clearneſs; for had the Tunicles and Humours of the Eye, all, or any of them, been colorate, many of the Rays proceeding from the viſible Object would have been ſtopt and ſuffocated before they could come to the bottom of the Eye, where the formal Organ of Viſion is ſituate; for it is a moſt certain Rule, how much any Body hath of Colour, ſo much hath it of Opacity; and by ſo much the more unfit it is to tranſmit the Species.

Secondly, For the Diſtinctneſs of Viſion: For, as I ſaid before, and the *Peripateticks* obſerve well, were the Humours of the Eye tinctur'd with any Colour, they would refund that Colour upon the Object, and ſo it would not be repreſented to the Soul as in it ſelf it is; ſo we ſee that thro'

thro' a colour'd Glaſs things appear as well more dim and obſcure as tinctur'd with the Colour thereof.

Secondly, The Parts of the Eye are made convex, and eſpecially the cryſtalline Humour, which is of a lenticular Figure, convex on both ſides, that by the Refractions there made, there might be a Direction of many Rays coming from one Point in the Object, *viz.* as many as the Pupil can receive, to one Point anſwerable in the bottom of the Eye, without which the Senſe would be very obſcure, and alſo confus'd. There would be as much difference in the Clearneſs and Diſtinction of Viſion, were the outward Surface of the *Tunica Cornea* plain, and the cryſtalline Humour remov'd, as between the Picture receiv'd on white Paper in a dark Room thro' an open or empty Hole, and the ſame receiv'd through a Hole furniſh'd with an exactly poliſh'd lenticular Cryſtal; which, how great it is, any one that hath but ſeen this Experiment made, knows well enough; indeed this Experiment doth very much explain the manner of Viſion, the Hole anſwering to the Pupil of the Eye, the cryſtalline Humour to the lenticular Glaſs, the dark Room to the Cavity containing the vitreous Humour, and the white Paper to the *Tunica Retina*.

Thirdly, The uveous Coat, or *Iris* of the Eye, hath a muſculous Power, and can dilate and contract that round Hole in it call'd the Pupil, or Sight

Sight of the Eye; it contracts it, for the excluding superfluous Light, and preserving the Eye from being injur'd by too vehement and lucid an Object, and again dilates it, for the apprehending Objects more remote, or plac'd in a fainter Light; *tam miro artificio* (saith *Scheiner*) *quam munifica naturæ largitate.* If any one desires to make Experiment of these Particulars, he may, following *Scheiner* and *Des Cartes* their Direction, take a Child, and setting a Candle before him, bid him look upon it, and he shall observe his Pupil contract it self very much, to exclude the Light, with the Brightness whereof it would otherwise be dazzled and offended; as we are, when after we have been some time in the dark, a bright Light is suddenly brought in and set before us, till the Pupils of our Eyes have gradually contracted themselves; let the Candle be withdrawn or remov'd aside, he shall observe the Child's Pupil by degrees to dilate it self; or let him take a Bead, or the like Object, and holding it near the Eye, command the Child to look at it, the Pupil will contract much when the Object is near; but let it be withdrawn to a greater distance in the same Light, and he shall observe the Pupil to be much enlarg'd.

Fourthly, The uveous Coat, and also the inside of the *Chorides*, are blacken'd, like the Walls of a Tennis-Court, that the Rays may be there suffocated and suppressed, and not reflected backwards, to confound the Sight; and if any be by

the

the retiform Coat reflected, they are ſoon choak'd in the black inſide of the *Uvea*; whereas were they reflected to and fro, there could be no diſtinct Viſion; as we ſee the Light admitted into the dark Room we even now ſpeak of, obliterates the *Species* which before were ſeen upon the white Cloth or Paper.

Fifthly, Becauſe the Rays from a nearer and from a more remote Object do not meet juſt in the ſame diſtance behind the cryſtalline Humour (as may eaſily be obſerv'd in lenticular Glaſs, where the Point or Concourſe of the Rays from a nearer Object is at a greater diſtance behind the Glaſs, and from a farther at a leſſer) therefore the *ciliary Proceſſes*, or rather the Ligaments obſerv'd in the inſide of the ſclerotick Tunicles of the Eye by a late ingenious Anatomiſt, do ſerve inſtead of a Muſcle, by their Contraction to alter the Figure of the Eye, and make it broader, and conſequently draw the *Retina* nearer to the cryſtalline Humour; and by their Relaxation ſuffer it to return to its natural diſtance, according to the Exigency of the Object, in reſpect of Diſtance or Propinquity; and beſides, poſſibly the ciliary Proceſſes may, by their Conſtriction or Relaxation, render the Cryſtalline it ſelf more gibboſe or plain, and with the help of the Muſcles a little alter the Figure of the whole Eye for the ſame reaſon. To what I have ſaid might be added, that the *retiform* Tunicle is whitiſh, for the better and more true Reception of the *Species* of Things;

Things; that there being a distance necessarily required for the Collection of the Rays receiv'd by the Pupil, *viz.* those that proceed from one Point of the Object to one Point again in the bottom of the Eye, the *Retina* must needs be set at a distance from the crystalline Humour; and therefore Nature hath provided a large Room, and fill'd it with the pellucid vitreous Humour, most fit for that purpose.

I must not omit a notable Observation concerning the Place of the Insertion of the optick Nerve into the Bulb of the Eye, and the reason of it; which I owe to that learned Mathematician *Peter Herigon: Nervus opticus* (saith he in his *Optica) ad latus ponitur, ne pars imaginis in ejus foramen incidens picturâ careat: The Optick Nerve is not situate directly behind the Eye, but on one side, lest that Part of the Image that falls upon the Hole of the optick Nerve should want its Picture.* This I do not conceive to be the true Reason of this Situation; for even now as it is situate, that Part of the Object whose Rays fall upon the Center, or Hole of the optick Nerve, wants its Picture, as we find by Experience, that Part not being seen by us, tho' we heed it not; but the reason is, because if the optick *Axis* should fall upon this Center (as it would do were the Nerve seated just behind the Eye) this great Inconvenience would follow, that the middle Point of every Object we view'd would be invisible, or there would be a dark Spot appear in the midst of it;

thus we see the admirable Wisdom of Nature in thus placing the optick Nerve in respect of the Eye, which he that did not consider or understand, would be apt to think more inconveniently situate for Vision than if it had been right behind.

Another thing also concerning Vision is most remarkable, that tho' there be a Decussation of the Rays in the Pupil of the Eye, and so the Image of the Object in the *Retina* or bottom of the Eye be inverted, yet doth not the Object appear inverted, but in its right or natural Posture; the reason whereof is, because the visual Rays coming in straight Lines by those Points of the Sensory or *Retina* which they touch, affect the common Sense or Soul, according to their Direction; that is, signify to it, that those several Parts of the Object from whence they proceed lie in straight Lines (Point for Point) drawn thro' the Pupil to the several Points of the Sensory, where they terminate, and which they press upon; whereupon the Soul must needs conceive the Object, not in an inverted, but a right Posture; and that the Nerves are naturally made, not only to inform the Soul of external Objects which press upon them, but also of the Situation of such Objects, is clear; because if the Eyes be distorted, the Object, will we nill we, will appear double; so if the fore and middle Fingers be cross'd, and a round Body put between them, and mov'd, it will seem to be two; the reason is, because in that

that Posture of the Fingers the Body touches the outsides of them, which in their natural Site are distant one from another, and their Nerves made to signify to the Soul Bodies separate, and distant in like manner, two Fingers lying between them; and tho' our Reason, by the help of our Sight, corrects this Error, yet cannot we but fancy it to be so.

Neither is the *aqueous Humour*, as some may supinely imagine, altogether useless or unprofitable as to Vision, because by its Help the *Uvea Tunica* is sustained, which else would fall flat upon the crystalline Humour; and fluid it must be to give way to the Contraction and Dilatation of the uveous; and because the outermost Coat of the Eye might chance to be wounded or pricked, and this Humour, being fluid, let out, therefore Nature hath made Provision speedily to repair it again in such a Case, by the help of certain Water-Pipes, or Lymphæducts, inserted into the Bulb of the Eye, proceeding from Glandules design'd by Nature to separate this Water from the Blood for that Use. *Antonius Nuck* affirms, that if the Eye of an Animal be prick'd, and the aqueous Humour squeez'd out, in ten Hours Space the said Humour and Sight shall be restored to the Eye, if at least the Creature be kept in a dark Place. And that he did publickly demonstrate the same in the Anatomical Theatre at *Leyden*, in a Dog, out of whose Eye, being wounded, the aqueous Humour did

ſo copiouſly flow, that the Membranes appear'd flaccid, and yet in ſix Hours Space the Bulb of the Eye was again replete with its Humour, and that without the Application of any Medicines. *Antonius Nuck de Ductu novo ſalivali*, &c.

Moreover, it is remarkable, that the *Cornea Tunica* [horny or pellucid Coat of the Eye] doth not lie in the ſame *Superficies* with the White of the Eye, but riſeth up, as it were a Hillock, above its Convexity, and is of an *hyperbolical* or *parabolical* Figure; ſo that tho' the Eye ſeems to be perfectly round, in reality it is not ſo, but the *Iris* thereof is protuberant above the White; and the reaſon is, becauſe that if the *Cornea Tunica*, or cryſtalline Humour, had been concentrical to the *Selerodes*, the Eye could not have admitted a whole Hemiſphere at one View, *& ſic Animalis incolumitati in multis rebus minùs cautum eſſet*, as *Scheiner* well obſerves. In many things there had not been ſufficient Caution or Care taken for the Animal's Safety.

Dr. More's *Antidote againſt Atheiſm.*

And now (that I may uſe the Words of a late Author of our own) the Eye is already ſo perfect, that I believe the Reaſon of a Man would eaſily have reſted here, and admir'd at his own Contrivance. For he being able to move his whole Body upward and downward, and on every ſide, might have unawares thought himſelf ſufficiently well provided for; but Nature hath added Muſcles alſo to the Eyes, that no Perfection

might be wanting; for we have often occasion to move our Eyes, our Head being unmov'd, as in reading and viewing more particularly an Object set before us, by transferring the *Axes* of our Eyes all over it; and that this may be done with the more Ease and Accuracy, she hath furnish'd this Organ with no less than six Muscles, to move it upward, downward, to the Right and Left, obliquely, and round about.

I shall now consider what Provision is made for the Defence and Security of this most excellent and useful Part.

First, The Eyes are sunk in a convenient Valley, *latent utiliter*, and are encompassed round with eminent Parts, as with a Rampart, *& excelsis undique partibus sepiuntur*, * *Cic.* so are defended from the Strokes of any flat or broad Bodies. Above stand the Eye-brows, to keep off any thing from running down upon them, as Drops of Sweat from the Forehead, or Dust, or the like. *Superiora superciliis obducta sudorem à capite & fronte defluentem repellunt.* Cic. Then follow the *Eye-lids*, which fence them from any sudden and lesser Stripes; these also round the Edges are fortified with stiff Bristles, as it were Palisadoes, against the Incursions of importunate Animals, serving partly as a Fan to strike away Flies, or Gnats, or any other troublesome Insect; and partly to keep off superfluous Light. *Munitæque sunt palpebræ tanquam*

* *De Natura deorum, l. 2.*

tanquam vallo pilorum, quibus & apertis oculis fiquid insideret repelleretur. Idem, ibid. And becauſe it was neceſſary that Man and other Animals ſhould ſleep, which could not be ſo well done if the Light came in by the Windows of the Eyes, therefore hath Nature provided theſe Curtains to be then drawn to keep it out. And becauſe the outward Coat of the Eye ought to be pellucid, to tranſmit the Light, which, if the Eyes ſhould always ſtand open, would be apt to grow dry and ſhrink, and loſe their Diaphaneity, therefore are the Eye-lids ſo contriv'd as often to wink, that ſo they may as it were glaze and varniſh them over with the Moiſture they contain, there being Glandules on purpoſe to ſeparate a Humour for that Uſe, and withal wipe off whatever Duſt or Filth may ſtick to them; and this, leſt they ſhould hinder the Sight, they do with the greateſt Celerity. *Cicero* hath taken notice, that they are made very ſoft, leſt they ſhould hurt the Sight. *Moliſſimè tactu nè læderent aciem, aptiſſimè facta & ad claudendas pupillas ne quid incideret, & ad aperiendas, idque providit ut identidem fieri poſſet maxima cum celeritate.*

Secondly, If we conſider the Bulb or Ball of the Eye, the exterior Membrane or Coat thereof is made thick, tough and ſtrong, that it is a very hard matter to make a Rupture in it, and beſides ſo ſlippery, that it eludes the Force of any Stroke, to which alſo its globular Figure gives it a very great Advantage.

Laſtly, Becauſe for the Guidance and Direction of the Body in walking, and any Exerciſe, it is neceſſary the Eye ſhould be uncover'd and expos'd to the Air at all Times and in all Weathers, therefore the moſt wiſe Author of Nature hath provided for it a hot Bed of Fat, which fills up the Interſtices of the Muſcles, and beſides made it more patient and leſs ſenſible of Cold than our other Parts; and tho' I cannot ſay with *Cicero*, abſolutely free from Danger or Harm by that Enemy, yet leaſt obnoxious to the Injuries thereof of any Part, and not at all, unleſs it be immoderate and extreme.

To all this I might add the Convenience of the Situation of the Eye in reſpect of its Proximity to the Brain, the Seat of Apprehenſion and common Senſe; whereas had it been farther remov'd, the *Optick Nerves* had been liable to many more Dangers and Inconveniences than now they are.

Seeing then the Eye is compos'd of ſo great Variety of Parts, all conſpiring to the Uſe of Viſion, whereof ſome are abſolutely neceſſary, others very uſeful and convenient, none idle or ſuperfluous; and which is remarkable, many of them of a different Figure and Conſiſtency from any others in the Body beſides, as being tranſparent, which it was abſolutely neceſſary they ſhould be, to tranſmit the Rays of Light; who can but believe that this Organ was deſign'd and made purpoſely for the Uſe for which it ſerves?

Neither

Neither is it to be eſteem'd any Defect or Imperfection in the Eyes of Man, that they want the ſeventh Muſcle, or the nictating Membrane, which the Eyes of many other Animals are furniſh'd withal; for tho' they be very uſeful, and in a manner neceſſary to them, conſidering their manner of living, yet they are not ſo to Man. To ſuch Beaſts as feed upon Graſs, and other Herbs, and therefore are forc'd to hold their Eyes long in a hanging Poſture, and to look downwards for the chuſing and gathering of their Food, the ſeventh or ſuſpenſory Muſcle is very uſeful, to enable them to do ſo without much Pain or Wearineſs; yet to Man, who doth not, nor hath any occaſion, indeed cannot hold his Head or look long downwards, it would be uſeleſs and ſuperfluous. As for the nictating Membrane, or *Periophthalmium*, which all Birds, and I think moſt Quadrupeds are furniſh'd with, I have been long in doubt what the Uſe of it might be, and have ſometimes thought it was for the more abundant Defence and Security of the Eye; but then I was puzzled to give any tolerable Account why Nature ſhould be more ſollicitous for the Preſervation of the Eyes of Brutes than Men, and in this Reſpect alſo to be a Step-mother to the moſt noble Creature.

But the honourable * Author formerly mention'd gives a probable Account why Frogs and Birds are furniſh'd

* Boyle *of final Cauſes*, p. 53, 54.

with such a Membrane. Frogs, because being amphibious Animals, design'd to pass their Lives in watery Places, which for the most part abound with Sedges, and other Plants endow'd with sharp Edges or Points; and the progressive Motion of this Animal being to be made not by walking, but by leaping, if his Eyes were not provided of such a Sheath, he must either shut them, and so leap blindly, and by consequence dangerously, or by leaving them open run a venture to have the *Cornea* cut, prick'd, or otherwise offended by the Edges or Points of the Plants, or what may fall from them upon the Animal's Eye; whereas this Membrane (being something transparent as well as strong) is like a kind of Spectacle, that covers the Eye without taking away the Sight. Birds are likewise furnish'd with it, because being destinated to fly among the Branches of Trees and Bushes, their Prickles, Twigs, Leaves, or other Parts, would be apt otherwise to wound or offend their Eyes. But yet still we are to seek why it is given to other Quadrupeds, whose Eyes are in no such danger.

Thirdly, The *Ear*, another Organ of Sense, how admirable it is contriv'd for the receiving and conveying of Sounds. *First*, There is the outward Ear, or *Auricula*, made hollow, and contracted by degrees, to draw the Sound inward, to take in as much as may be of it, as we use a Funnel to pour Liquor into any Vessel; and

therefore

therefore if the *Auricula* be cut clear off the Hearing is much impair'd, and almoſt quite marr'd, as hath been by Experience found. From the *Auricula* is extended a ſmall, long, round Hole inward into the Head, to intend the Motion, and ſo augment the Force of the Sound, as we ſee in a Shooting-Trunk, the longer it is to a certain Limit, the ſwifter and more forcibly the Air paſſes in it and drives the Pellet. At the end of this Hole is a Membrane faſten'd to a round boney Limb, and ſtretch'd like the Head of a Drum, and therefore by Anatomiſts call'd alſo *Tympanum*, to receive the Impulſe of the Sound, and to vibrate or quaver according to its reciprocal Motions or Vibrations; the ſmall Ear-bones being at the end faſten'd to the *Tympanum*, and furniſh'd with a Muſcle, ſerve for the Tenſion of that Membrane, or the Relaxation of it, according to the Exigency of the Animal, it being ſtretch'd to the utmoſt when it would hearken diligently to a lower or more diſtant Sound. Behind the Drum are ſeveral Vaults and anfractuous Cavities in the Ear-bone, fill'd only with what Naturaliſts call the implanted Air, ſo to intend the leaſt Sound imaginable that the Senſe might be affected with it; as we ſee in ſubterraneous Caves and Vaults how the Sound is redoubled, and what a great Report it makes however moderate it be; and becauſe it was for the behoof of the *Animal*, that upon any ſudden Accident it might be awaken'd out of its Sleep, therefore

were there no Shuts or Stopples made for the Ears, that ſo any loud or ſharp Noiſe might awaken it, as alſo a ſoft and gentle Voice of Murmur provoke it to ſleep. Now the Ears, for the Benefit and Conveniences of the *Animal*, being always to ſtand open, becauſe there was ſome danger that Inſects might creep in thereat, and eating their way thro' the *Tympanum* harbour in the Cavities behind it, therefore hath Nature loricated or plaiſter'd over the ſides of the forementioned Hole with Ear-wax, to ſtop and entangle any Inſects that ſhould attempt to creep in there. But I muſt confeſs my ſelf not ſufficiently to underſtand the nature of Sounds, to give a full and ſatisfactory Account of the Structure and Uſes of all the Parts of the Ear; they who have a mind to ſearch into the curious Anatomy and Uſe of this Part, may conſult Monſieur *du Verney*.

Fourthly, The next Part I ſhall take notice of ſhall be the *Teeth*, concerning which I find ſeven Obſervations in the honourable Mr. *Boyle*'s Treatiſe *of final Cauſes*, which I ſhall briefly recapitulate, and add one or two more.

I. That the Teeth alone, among the Bones, continue to grow in length during a Man's whole Life, as appears by the unſightly Length of one Tooth, when its Oppoſite happens to fall or be pull'd out, which was moſt providently deſign'd to repair the Waſte that is daily made of them by

by the frequent Attrition in Mastication. Here, by the by, I might advise Men to be careful how they attempt to cure this Blemish, by filing or cutting off the head of such an overgrown Tooth, lest that befal them which happen'd to a certain Nun in *Padua*, who upon cutting off a Tooth in that manner, was presently convulsed, and fell into an Epilepsy, as *Bartholine* in his *Anatomy* reports.

II. That that Part of the Teeth which is extant above the Gums is naked, and not invested with that sensible Membrane call'd *Periosteum*, wherewith the other Bones are cover'd.

III. That the Teeth are of a closer and harder Substance than the rest of the Bones, for the more easy breaking and comminution of the more solid Aliments, and that they might be more durable, and not so soon worn down by grinding the Food.

IV. That for the nourishing and cherishing these so necessary Bones, the all-wise Author of Things has admirably contriv'd an unseen Cavity in each side of the Jaw-bone, in which greater Channel are lodg'd an Artery, a Vein, and a Nerve, which thro' lesser Cavities, as it were thro' Gutters, send their Twigs to each particular Tooth.

V. Because

V. Becauſe Infants were for a conſiderable Time to feed upon Milk, which needs no chewing, and left Teeth ſhould hurt the tender Nipples of the Nurſe, Nature hath deferr'd the Production of them for many Months in a human *Fœtus*; whereas thoſe of divers other Animals, which are reduc'd to ſeek betimes Food that needs Maſtication, are born with them.

VI. The different Figure and Shape of the Teeth is remarkable. That the fore Teeth ſhould be form'd broad, and with a thin and ſharp Edge, like Chiſſels, to cut off and take away a Morſel from any ſolid Food, call'd therefore *Inciſores*. The next, one on each ſide, ſtronger, and deeper rooted, and more pointed, call'd therefore *Canini*, in *Engliſh*, Eye-Teeth, to tear the more tough and reſiſting ſort of Aliments. The reſt, call'd Jaw-teeth, or Grinders, in *Latin*, *Molares*, are made flat and broad a-top, and withal ſomewhat uneven and rugged, that by their Knobs and little Cavities they may the better retain, grind, and commix the Aliments.

VII. Becauſe the Operations to be perform'd by the Teeth oftentimes require a conſiderable Firmneſs and Strength, partly in the Teeth themſelves, partly in the Inſtruments which move the lower Jaw, which alone is moveable, Nature hath provided this with ſtrong Muſcles, to make it bear forcibly againſt the upper Jaw; and thus not

not only plac'd each Tooth in a distinct Cavity of the Jaw-bone, as it were in a close, strong, and deep Socket, but has furnish'd the several Sorts of Teeth with Holdfasts suitable to the Stress, that by reason of their different Offices they are to be put to; and therefore, whereas the *Cutters* and *Eye-teeth* have usually but one Root (which in these last nam'd is wont to be very long) the *Grinders*, that are employ'd to crack Nuts, Stones of Fruit, Bones, or other hard Bodies, are furnish'd with three Roots, and in the upper Jaw often with four, because these are pendulous, and the Substance of the Jaw somewhat softer.

VIII. The Situation of the Teeth is most convenient, *viz.* the *Molares* or *Grinders* behind, neareſt the Center of Motion, because there is a greater Strength or Force required to chew the Meat than to bite a piece; and the *Cutters* before, that they may be ready to cut off a Morsel from any solid Food, to be transmitted to the *Grinders*.

IX. It is remarkable that the Jaw in Men, and such Animals as are furnish'd with Grinders, hath an oblique and transverse Motion, which is necessary for chewing and comminution of the Meat, which it is observ'd not to have in those Animals that want the *Molares*.

Now

Now if (as *Galen* ſaith) he that ſhall marſhal a Company but of Thirty-two Men in due Order, is commended for a ſkilful and induſtrious Perſon, ſhall we not admire Nature, which hath ſo ſkilfully rank'd and diſpos'd this Quire of our Teeth?

Fifthly, The *Tongue* is no leſs admirable for the Contexture and manifold Uſes of it. *Firſt*, It is the Organ of Taſting; for being of a ſpongy Subſtance, the ſmall Particles of our Meat and Drink being mingled with the *Saliva*, eaſily inſinuate themſelves into the Pores of it, and ſo do either gratefully affect it, or harſhly grate upon it, accordingly as they are figur'd and mov'd; and hereby we diſcern what is convenient or inconvenient for our Nouriſhment. It helps us likewiſe in the chewing and ſwallowing of our Meat. And *laſtly*, it is the main Inſtrument of Speaking, a Quality ſo peculiar to Man, that no Beaſt could ever attain to it. And altho' Birds have been taught to form ſome Words, yet they have been but a few, and thoſe learn'd with great difficulty; but what is the chief, the Birds underſtand not the meaning of them, nor uſe them as Signs of Things, or their own Conceptions of them, tho' they may uſe them as Expreſſions of their Paſſions; as Parrots having been uſed to be fed at the Prolation of certain Words, may afterwards, when they are hungry, pronounce the ſame. For this *Des Cartes* makes his main

main Argument to prove that Brutes have no Cogitation, becauſe the higheſt of them could never be brought to ſignify their Thoughts or Conceptions by any artificial Signs, either Words or Geſtures (which, if they had any, they would in all likelihood be forward enough to do;) whereas all Men, both Fools and Mutes, make uſe of Words or other Signs to expreſs their Thoughts about any Subjects that preſent themſelves, which Signs alſo have no reference to any of their Paſſions; whereas the Signs that brute Animals may be taught to uſe, are no other than ſuch as are the Motions of ſome of their Paſſions, Fear, Hope, Joy, *&c.* Hence ſome of the *Jewiſh* Rabbins did not ſo abſurdly define a Man * *Animal loquens*, a ſpeaking * חיה מדברת Creature. Having had occaſion juſt now to mention the *Saliva*, or Spittle, I am put in mind of the eminent Uſe of this Humour, which is commonly taken for an Excrement. Becauſe a great Part of our Food is dry, therefore Nature hath provided ſeveral Glandules to ſeparate this Juice from the Blood, and no leſs than four Pair of Channels to convey it into the Mouth, which are of late Invention, and call'd by Anatomiſts *Ductus Salivales*, thro' which the *Saliva* diſtilling continually, ſerves well to macerate and temper our Meat, and make it fit to be chew'd and ſwallow'd. If a copious Moiſture did not by theſe Conduit-Pipes inceſſantly flow down into the Mouths of *Horſes* and *Kine*, how were it poſſible they ſhould for a long time together

gether grind and ſwallow ſuch dry Meat as Hay and Straw? Moreover, it is uſeful not only in the Mouth, but in the Stomach too, to promote Concoction, as we have already noted.

Sixthly, To the Mouth ſucceeds the *Windpipe*, no leſs wonderful in its Conformation; for becauſe continual Reſpiration is neceſſary for the Support of our Lives, it is made with annulary Cartilages, to keep it conſtantly open, and that the ſides of it may not flag and fall together; and leſt, when we ſwallow, our Meat or Drink ſhould fall in there and obſtruct it, it hath a ſtrong Shut or Valve, call'd *Epiglottis*, to cover it cloſe and ſtop it when we ſwallow: For the more convenient bending of our Necks, it is not made of one entire continu'd Cartilage, but of many annular ones, join'd together by ſtrong Membranes, which Membranes are muſcular, compounded of ſtraight and circular Fibres, for the more effectual Contraction of the Windpipe in any ſtrong or violent Expiration or coughing; and leſt the Aſperity or Hardneſs of their Cartilages ſhould hurt the *Oeſophagus* or Gullet, which is tender, and of a ſkinny Subſtance, or hinder the ſwallowing of our Meat, therefore theſe annulary Griſtles are not made round, or entire Circles; but where the Gullet touches the Windpipe, there to fill up the Circle, is only a ſoft Membrane, which may eaſily give way to the Dilation of the Gullet; and to demonſtrate that this was deſignedly done for this End and Uſe,

ſo

ſo ſoon as the Windpipe enters the Lungs, its Cartilages are no longer deficient, but perfect Circles or Rings, becauſe there was no neceſſity they ſhould be ſo, but it was more convenient they ſhould be entire. *Laſtly*, For the various Modulation of the Voice, the upper end of the Windpipe is endu'd with ſeveral Cartilages and Muſcles, to contract or dilate it, as we would have our Voice flat or ſharp; and moreover, the whole is continually moiſten'd with a glutinous Humour, iſſuing out of the ſmall Glandules that are upon its inner Coat, to fence it againſt the ſharp Air receiv'd in, or Breath forc'd out; yet is it of quick and tender Senſe, that it may be eaſily provok'd to caſt out by coughing whatever may fall into it from without, or be diſcharg'd into it from within.

It is alſo very remarkable which *Caſpar Bartholine* hath obſerv'd in the Gullet, that where it perforateth the Midriff, the carneous Fibres of that muſcular Part are inflected and arcuate, as it were a *Spincter* embracing and cloſing it faſt, by a great Providence of Nature, leſt in the perpetual motion of the ſaid Midriff the upper Orifice of the Stomach ſhould gape, and caſt out the Victuals as faſt as it receiv'd it.

Seventhly, The *Heart*, which hath been always eſteem'd, and really is one of the principal Parts of the Body, the *primum vivens, & ultimum moriens*, the firſt Part that quickens, and the laſt

that dies, by its inceſſant Motion diſtributing the Blood, the Vehicle of Life, and with it the vital Heat and Spirits, throughout the whole Body, whereby it doth continually irrigate, nouriſh, and keep hot, and ſupple all the Members. Is it not admirable that from this Fountain of Life and Heat there ſhould be Channels and Conduit-pipes to every, even the leaſt and moſt remote Part of the Body? Juſt as if from one Water-houſe there ſhould be Pipes conveying the Water to every Houſe in a Town, and to every Room in each Houſe; or from one Fountain in a Garden there ſhould be little Channels or Dikes cut to every Bed, and every Plant growing therein, as we have ſeen more than once done beyond the Seas. I confeſs the Heart ſeems not to be deſign'd to ſo noble an Uſe as is generally believ'd, that is, to be the Fountain or Conſervatory of the vital Flame, and to inſpire the Blood therewith (for the Lungs ſerve rather for the Accenſion, or maintaining that Flame, the Blood receiving there from the Air thoſe Particles which are one Part of the *Pabulum*, or Fuel thereof, and ſo impregnated, running back to the Heart) but to ſerve as a Machine to receive the Blood from the Veins, and to force it out by the Arteries thro' the whole Body, as a Syringe doth any Liquor, though not by the ſame Artifice; and yet this is no ignoble Uſe, the continuance of the Circulation of the Blood being indiſpenſably neceſſary for the quickning and enlivening of all the Members of the Body, and ſupplying of Matter to the Brain, for the Preparation of the animal Spi-

rits,

rits, the Inſtruments of all Senſe and Motion. Now for this Uſe of receiving and pumping out of the Blood, the Heart is admirably contriv'd. For, *Firſt*, being a muſcular Part, the Sides of it are compos'd of two Orders of Fibres, running circularly or ſpirally from Baſe to Tip, contrarily one to the other, and ſo being drawn or contracted contrary ways, do violently conſtringe and ſtraiten the Ventricles, and ſtrongly force out the Blood, as we have formerly intimated; then the Veſſels we call *Arteries*, which carry from the Heart to the ſeveral Parts, have Valves, which open outwards, like Trap-doors, and give the Blood a free Paſſage out of the Heart, but will not ſuffer it to return back again thither; and the *Veins*, which bring it back from the ſeveral Members to the Heart, have Valves or Trap-doors, which open inwards, ſo as to give way unto the Blood to run into the Heart, but prevent it from running back again that way; beſides, the Arteries conſiſt of a quadruple Coat, the third of which is made up of annular or orbicular carneous Fibres to a good thickneſs, and is of a muſcular nature, after every Pulſe of the Heart, ſerving to contract the Veſſel ſucceſſively with incredible Celerity, ſo by a kind of periſtaltick Motion impelling the Blood onwards to the capillary Extremities and thro' the Muſcles with great Force and Swiftneſs; ſo the Pulſe of the Arteries is not only caus'd by the Pulſation of the Heart driving the Blood thro' them in manner

of a Wave or Flush, as *Des Cartes* and others would have it, but by the Coats of the Arteries themselves, which the Experiments of a certain * *Lovain* Physician (the first whereof is *Galen*'s) do, in my Opinion, make good against him.

* Cartes *Ep. V.* 1. *Ep.* 77. & *Sep.*

" First, *saith he*, if you slit the Artery, and " thrust into it a Pipe, so big as to fill the Cavi- " ty of it, and cast a strait Ligature upon that " Part of the Artery containing the Pipe, and so " bind it fast to the Pipe; notwithstanding the " Blood hath free Passage thro' the Pipe, yet " will not the Artery beat below the Ligature; " but do but take off the Ligature, it will com- " mence again to beat immediately." But because one might be ready to reply to this Experiment, that the reason why when bound it did not beat, was because the Current of the Blood being straiten'd by the Pipe, when beneath the Pipe it came to have more liberty, was not sufficient to stretch the Coat of the Artery, and so cause a Pulse, but when the Ligature was taken off it might flow between the inclos'd Tube and the Coat of the Artery; therefore he adds another, which clearly evinces that this could not be the reason, but that it is something flowing down the Coats of the Artery that causes the Pulse; that is, if you straiten the Artery never so much, provided the Sides of it do not quite meet and stop all Passage of the Blood, the Vessel will notwithstanding continue still to beat below or beyond the Coarctation. So we see some Physi-

cians,

cians, both ancient (as *Galen)* and modern, were of opinion that the Pulſe of the Arteries was owing to their Coats; tho' the firſt that I know of who obſerv'd the third Coat of an Artery to be a muſcular Body, compos'd of annular Fibres, was Dr. *Willis.* This mention of the periſtaltick Motion puts me in mind of an ocular Demonſtration of it in the Gullet of Kine when they chew the Cud, which I have often beheld with Pleaſure; for after they have ſwallow'd one Morſel, if you look ſtedfaſtly upon their Throat you will ſoon ſee another aſcend, and run pretty ſwiftly all along the Throat up to the Mouth, which it could not do, unleſs it were impell'd by the ſucceſſive Contraction or periſtaltick Motion of the Gullet continually following; and it is remarkable that theſe ruminant Creatures have a Power by the *Imperium* of their Wills of directing this periſtaltick Motion upwards or downwards. I ſhall add no more concerning the Heart, but that it and the Brain do *mutuas operas tradere*, enable one another to work; for, *firſt*, the Brain cannot itſelf live unleſs it receive continual Supplies of Blood from the Heart, but leſs can it perform its Functions, of preparing and diſtributing the animal Spirits, nor the Heart Pulſe, unleſs it receives Spirits or ſomething elſe that deſcends from the Brain by the Nerves; for do but cut aſunder the Nerves that go from the Brain to the Heart, the Motion thereof, in moſt perfect and hot Creatures, ceaſeth immediately. Which Part began this Round is the Queſtion.

I find in the *Philosophical Transactions*, N° 280. some notable Observations of the famous Anatomist Mr. *William Cowper*, concerning the Artifice of Nature in regulating the Motion of the Blood in the Veins and Arteries, to assist and promote it in the one, and moderate it in the other, which I shall give you in his own Words.

" As the *Arteries* (saith he) are known to ex-
" port the Blood, so the *Veins* to carry it back
" again to the Heart; but having already descri-
" bed their Extremities, we come now to the
" large Trunks of the *Veins*; and here, as in the
" *Arteries*, we find the common Practice of Na-
" ture, in disposing the Branches of Veins to dis-
" charge the refluent Blood into the next adjacent
" Trunk, and so on to the Heart. As the *Arte-*
" *ries* afford abundance of Instances of Checks
" given to the Velocity of the Current of Blood
" thro' several Parts, so the *Veins* supply us with
" as many Artifices to assist its regular Return to
" the *Heart*, as well as favour those Contrivan-
" ces in the *Arteries*.

" The *carotid*, *vertebral*, and *splenick Arteries*,
" are not only variously contorted, but also here
" and there dilated, to moderate the Motion of
" the Blood; so the *Veins* that correspond to
" those *Arteries* are also variously dilated. The
" Beginnings of the internal *Jugulars* have a bul-
" bous Cavity, which are *diverticula* to the re-
" fluent Blood in the *Sinus's* of the *Dura Mater*,

" leſt it ſhould deſcend too faſt into the *Jugu-*
" *lars.* The like has been taken notice of by
" Dr. *Lower* in the *vertebral Sinus's.* The *ſple-*
" *nick Vein* has divers Cells opening into it near
" its Extremities in human Bodies, but in Qua-
" drupeds the Cells open into the Trunks of the
" ſplenick Veins.

" The *ſpermatick* Veins do more than equal the
" Length of the Arteries of the *Teſtes* in Men;
" their various Diviſions, and ſeveral Inoſcula-
" tions, and their Valves, are admirably contri-
" ved to ſuſpend the Weight of the Blood, in or-
" der to diſcharge it into the larger Trunks of
" the *Veins*; and were it not that the refluent
" Blood from the *Teſtes* is a *Pondus* to the influ-
" ent Blood from the *Arteries*, and ſtill leſſens
" its Current in the *Teſtes*, theſe ſpermatick Veins,
" like thoſe of other Parts, might have diſcharg'd
" the Blood into the next adjacent Trunk.

" Who can avoid Surprize at the Art of Na-
" ture, in contriving the *Veins* that bring part of
" the refluent Blood from the lower Parts of the
" Body, when they conſider the neceſſity of pla-
" cing the human Heart, as well as that of moſt
" Quadrupeds, ſo far from the Center of the
" Body towards its upper Part; it is for that
" End neceſſary that the large Trunks of the
" *Veins* and *Arteries* ſhould not aſſociate each
" other; for if all the Blood ſent to the lower
" Parts by the deſcending Trunk of the *Aorta*,
" ſhould return to the Heart again by one ſingle
" Trunk (as it is ſent out from thence) the

" Weight of ſo much Blood in the aſcending " Trunk of the *Vena Cava* would oppoſe all the " Force the Heart could give it from the Arte- " ries, and hinder its Aſcent; for this reaſon the " *Vena Azygos* or *ſine Pari* is contriv'd to convey " the Blood ſent to the Muſcles of the Back and " *Thorax* into the deſcending Trunk of the *Vena* " *Cava* above the Heart; hence it is evident that " more Blood comes into the Heart by the de- " ſcending or upper Trunk of the *Vena Cava*, " than paſſes out by the aſcending Trunk of the " *Aorta*; nor does the Quantity of Blood con- " vey'd to the Heart by the ſuperior Trunk of " the *Vena Cava*, ſeem, without ſome other De- " ſign in Nature beſides tranſporting it thither, " to free the inferior Trunk from its Weight; " but perhaps it was neceſſary ſo much Blood " ſhould be ready there to join with the *Chyle*, " for its better Mixture, before it reaches the " right Auricle of the Heart." *So far Mr.* Cowper.

Eighthly, The next Part I ſhall treat of ſhall be the *Hand*, this ὄργανον ὀργάνων, or ſuperlative Inſtrument, which ſerves us for ſuch a multitude of Uſes, as it is not eaſy to enumerate; whereto, if we conſider the Make and Structure of it, we ſhall find it wonderfully adapted. *Firſt*, It is divided into four Fingers bending forward, and one oppoſite to them bending backwards, and of greater Strength than any of them ſingly, which we call the Thumb, to join with them ſeverally

or

or united, whereby it is fitted to lay hold of Objects of any Size or Quantity; the leaſt things, as any ſmall ſingle Seed, are taken up by the Thumb and fore Finger, thoſe a little greater by the Thumb and two Fingers, which alſo we chiefly employ to manage the Needle in ſewing and the Pen in writing; when we would take up a greater Quantity of any thing, we make uſe of the Thumb and all the Fingers; ſometimes we uſe one Finger only, as in pointing at any thing, picking things out of Holes or long and narrow Veſſels; ſometimes all ſeverally at one time, as in ſtopping the Strings when we play upon any muſical Inſtruments. *Secondly*, The Fingers are ſtrengthen'd with ſeveral Bones, jointed together for Motion, and furniſh'd with ſeveral Muſcles and Tendons, like ſo many Pullies, to bend them circularly forwards, which is moſt convenient for the firm holding and griping of any Object; which of how great, conſtant and neceſſary Uſe it is in pulling or drawing, but eſpecially in taking up and retaining any ſort of Tool or Inſtrument to work withal in Huſbandry and all mechanick Arts, is ſo obvious to every Man's Obſervation, that I need not ſpend Time to inſtance in Particulars; moreover, the ſeveral Fingers are furniſh'd with ſeveral Muſcles, to extend and open the Hand, and to move to the Right and Left; and ſo this diviſion and motion of the Fingers doth not hinder but that the whole Hand may be employ'd as if it were all of a piece, as we ſee it is, either expanded, as in ſtriking out,

ſmoothing and folding up of Clothes, and ſome mechanick Uſes; or contracted, as in fighting, kneading of Dough, and the like; it is alſo notable, and indeed wonderful, that the Tendons bending the middle Joint of the Fingers ſhould be perforated, to give Paſſage to the Tendons of the Muſcles which draw the uppermoſt Joints, and all bound down cloſe to the Bone with ſtrong Fillets, leſt they ſhould ſtart up and hinder the Hand in its Work, ſtanding like ſo many Bow-ſtrings. *Thirdly*, The Fingers-ends are ſtrengthen'd with Nails, as we fortify the ends of our Staves and Forks with Iron Hoops or Ferules; which Nails ſerve not only for Defence, but for Ornament, and many Uſes. The Skin upon our Fingers-ends is thin, and of moſt exquiſite Senſe, to help us judge of any thing we handle. If now I ſhould go about to reckon up the ſeveral Uſes of this Inſtrument, Time would ſooner fail me than Matter. By the help of this we do all our Works, we build ourſelves Houſes to dwell in, we make ourſelves Garments to wear, we plow and ſow our Grounds with Corn, dreſs and cultivate our Vineyards, Gardens and Orchards, gather and lay up our Grain and Fruits, we prepare and make ready our Victuals; Spinning, Weaving, Painting, Carving, Engraving, and that divinely invented Art of Writing, whereby we tranſmit our own Thoughts to Poſterity, and converſe with and participate the Obſervations and Inventions of them that are long ago dead, all perform'd by this; this is the only Inſtrument

ſtrument for all Arts whatſoever, no Improvement to be made of any experimental Knowledge without it. Hence (as *Ariſtotle* ſaith well) they do amiſs that complain that Man is worſe dealt with by Nature than any other Creatures; whereas they have ſome Hair, ſome Shells, ſome Wool, ſome Feathers, ſome Scales, to defend themſelves from the Injuries of the Weather, Man alone is born naked and without all Covering; whereas they have natural Weapons to defend themſelves and offend their Enemies, ſome Horns, ſome Hoofs, ſome Teeth, ſome Talons, ſome Claws, ſome Spurs and Beaks; Man hath none of all theſe, but is weak and feeble, and unarm'd ſent into the World: why, a Hand, with Reaſon to uſe it, ſupplies the Uſes of all theſe, that's both a Horn and a Hoof, a Talon and a Tuſk, *&c.* becauſe it enables us to uſe Weapons of theſe and other faſhions, as Swords, and Spears, and Guns; beſides, this Advantage a Man hath of them, that whereas they cannot at pleaſure change their Coverings, or lay aſide their Weapons, or make uſe of others as Occaſion ſerves, but muſt abide Winter and Summer, Night and Day with the ſame Cloathing on their Backs, and ſleep with their Weapons upon them; a Man can alter his Cloathing according to the Exigency of the Weather, go warm in Winter and cool in Summer, cover up himſelf hot in the Night, and lay aſide his Cloaths in the Day, and put on or off more or fewer, according as his Work and Exerciſe is; and can, as Occaſion requires, make

Uſe

Uſe of divers Sorts of Weapons, and Choice of ſuch at all Turns as are moſt proper and convenient; whereby we are enabled to ſubdue and rule over all other Creatures, and uſe for our own Behoof thoſe Qualities wherein they excel, as the Strength of the Ox, the Valour and Swiftneſs of the Horſe, the Sagacity and Vigilancy of the Dog, and ſo make them as it were our own. Had we wanted this Member in our Bodies we muſt have liv'd the Life of Brutes, without Houſe or Shelter, but what the Woods and Rocks would have afforded, without Cloaths or Covering, without Corn, or Wine, or Oil, or any other Drink but Water; without the Warmth and Comfort, or other Uſes of Fire, and ſo without any artificial bak'd, boil'd, or roaſt Meats; but muſt have ſcrambled with the wild Beaſts for Crabs, and Nuts, and Acorns, and ſuch other things as the Earth puts forth of her own accord; we had laid open and expos'd to Injuries, and had been unable to reſiſt or defend ourſelves againſt almoſt the weakeſt Creature.

The remaining Parts I ſhall but briefly run over.

That the *Back-Bone* ſhould be divided into ſo many Vertebres for commodious bending, and not be one entire rigid Bone, which being of that Length would have been often in danger of ſnapping in ſunder; that it ſhould be made tapering, in form of a Pillar, the lower Vertebres being the broadeſt and largeſt, and the ſuperior in order leſſer and leſſer, for the greater Firmneſs and Stability

bility of the Trunk of the Body; that the ſeveral Vertebres ſhould be ſo elegantly and artificially compacted and join'd together, that they are as ſtrong and firm as if they were but one Bone; that they ſhould be all perforated in the middle, with a large Hole for the ſpinal Marrow or Pith to paſs along, and each Particular have a Hole on each ſide to tranſmit the Nerves to the Muſcles of the Body, to convey both Senſe and Motion; that by reaſon of the fore-mention'd cloſe Connexion of the Vertebres, it ſhould be ſo form'd as not to admit any great Flexure or Receſs from a right Line any angular, but only a moderate circular bending, leſt the ſpinal Pith ſhould be compreſs'd, and ſo the free Intercourſe or Paſſage of the Spirits to and fro be ſtopt.

One Obſervation relating to the Motion of the Bones in their Articulations I ſhall here add, that is, the Care that is taken and the Proviſion that is made for the eaſy and expediate motion of them, there being to that purpoſe a twofold Liquor prepar'd, for the Inunction and Lubrification of their Heads or Ends. 1. An oily one, furniſh'd by the Marrow. 2. A mucilaginous, ſupply'd by certain Glandules ſeated in the Articulations, both which together make up the moſt apt and proper Mixture for this Uſe and End that can be invented or thought upon; for not only both the Ingredients are of a lubricating nature, but there is this Advantage gain'd from their Compoſition, that they do mutually improve one another;

another; for the Mucilage adds to the Lubricity of the Oil, and the Oil preſerves the Mucilage from Inſpiſſation, and contracting the Conſiſtency of a Gelly. Now this Inunction is uſeful, indeed neceſſary, for three Ends chiefly.

1. For the facilitating of Motion. For tho' the Ends of the Bones are very ſmooth, yet were they dry they could not with that Readineſs and Eaſe, nay, not without great Difficulty, yield to and obey the Plucks and Attractions of the motory Muſcles; as we ſee Clocks and Jacks, tho' the Screws and Teeth of the Wheels and Nuts be never ſo ſmooth and poliſh'd, yet if they be not oil'd will hardly move, tho' you clog them with never ſo much Weight; but if you apply but a little Oil, they preſently whirl about very ſwiftly with the tenth Part of the Force.

2. For preſerving the Ends of the Bones from an Incaleſcency, which they, being hard and ſolid Bodies, would neceſſarily contract from a ſwift and long continuing Motion; ſuch as that of running, or mowing, or threſhing, or ſawing, and the like, if they are immediately touch'd and rubb'd againſt one another with that Force they muſt needs do, eſpecially in running, the whole Weight of the Body bearing upon the Joints of the Thighs and Knees. So we ſee in the Wheels of Waggons or Coaches, the Hollows of the Naves, by their ſwift Rotations on the Ends of the Axle-trees, produce a Heat, ſometimes ſo intenſe

tenſe as to ſet them on fire; to prevent which they ſtand in need to be frequently anointed or beſmear'd with a Mixture of Greaſe and Tar, imitating the fore-mention'd natural Compoſition of Oil and Mucilage. Nay, Bodies ſofter a great deal than Metals contract a great Heat by Attrition, as is evident from thoſe black circular Lines we ſee on Boxes, Diſhes, and other turn'd Veſſels of Wood, which are the Effects of Ignition, caus'd by the Preſſure of an edg'd Stick upon the Veſſel turn'd nimbly in the Lathe. And if there had not been a Proviſion in the Joints againſt ſuch a preternatural Incaleſcence upon their violent motion, this would have made a ſlothful World, and confin'd us to leiſurely and deliberate Movements, when there were the moſt urgent and haſty Occaſions to quicken us.

3. For the preventing of Attrition, and wearing down the ends of the Bones by their motion and rubbing one againſt another, which is ſo violent and laſting ſometimes, that it is a Wonder any Inunction ſhould ſuffice to ſecure their Heads from waſting and conſumption. I have often ſeen the Tops of the Teeth (which are of a harder Subſtance than the reſt of the Bones) worn off by Maſtication, in Perſons who have loſt moſt of their Grinders, and been compell'd conſtantly to make uſe of three or four only in chewing, ſo low, that at laſt the inward Marrow and Nerve lay bare, and they could no longer for Pain make uſe of them; ſo that had there not been this Proviſion

viſion made for the anointing the Bones, the curious Workmanſhip of Nature in adapting them ſo exactly one to another, as was moſt fit for the eaſy Performance of all thoſe Motions to which they were deſtin'd, would not ſuffice for Uſe; but the ſtirring Part of Mankind would ſoon find themſelves fitter for an Hoſpital than for Action and the Purſuit of Buſineſs.

Theſe Obſervations I acknowledge myſelf to have borrow'd of a late ingenious * Writer of *Oſteology*, who thus concludes his Diſcourſe upon this Subject. *And here we cannot avoid the Notice of the viſible Footſteps of an infinite Reaſon, which as they are deeply impreſs'd upon the Univerſe, ſo more eſpecially on the ſenſible Parts of it in thoſe rational Contrivances which are found in Animals: And we can never ſufficiently admire the Wiſdom and Providence of our great Creator, who has given all Parts in theſe animated Beings, not only ſuch a Structure as renders them fit for their neceſſary Motions and deſign'd Functions, but withal the Benefit and Advantage of whatever may preſerve them, or facilitate their Action.*

* Mr. *Clopton Havers.*

Moreover, the Artifice of Nature is wonderful in the Conſtruction of the Bones that are to ſupport the Body, and to bear great Burdens, or to be employ'd in ſtrong Exerciſes, they being made hollow, for Lightneſs and Stiffneſs. For we have before noted, a Body that is hollow may be demon-

demonſtrated to be more rigid and inflexible than a ſolid one of the ſame Subſtance and Weight; ſo that here is Proviſion made for the Stiffneſs and Lightneſs of the Bones. But the Ribs, which are not to bear any great Weight, or to be ſtrongly exercis'd, but only to fence the Breaſt, have no Cavity in them, and towards the fore part or Breaſt are broad and thin, that ſo they might bend and give way without danger of Fracture; when bent returning by their elaſtick Property to their Figure again. Yet is not the Hollow of the Bones altogether uſeleſs, but ſerves to contain the Marrow, which ſupplies an Oil for the maintaining and inunction of the Bones and Ligaments, and ſo facilitating their Motion in the Articulations; and particularly (which we mention'd not before) of the Ligaments, preſerving them from Dryneſs and Rigidity, and keeping them ſupple and flexible, and ready to comply with all the Motions and Poſtures of that moveable Part to which they appertain; and laſtly, to ſecure them from Diſruption, which, as ſtrong as they are, they would be in ſome danger of, upon a great and ſudden Stretch and Contortion, if they were dry, *&c.* See more to this Purpoſe in the Treatiſe fore quoted, *p.* 183.

That whereas the *Breaſt* is encompaſs'd with Ribs, the *Belly* is left free, that it might give way to the motion of the Midriff in Reſpiration, and to the neceſſary Reception of Meat and Drink,

as alſo for the convenient bending of the Body; and in Females for that extraordinary Extenſion that is requiſite in the time of their Pregnancy.

That the Lungs ſhould be made up of ſuch innumerable Air-pipes and Veſicles, interwoven with Blood-Veſſels, in order to purify, ferment, or ſupply the ſanguineous Maſs with Nitro-ærial Particles, which ruſh in by their elaſtick Power upon the muſcular Extenſion of the Thorax, and ſo feed the vital Flame and Spirits; for upon obſtructing this Communication all is preſently extinct, no Circulation, no Motion, no Heat, nor any Sign of Life remains.

That the *Stomach* ſhould be membranous, and capable of Dilatation and Contraction, according to the Quantity of Meat contain'd in it; that it ſhould be ſituate under the Liver, which by its Heat might cheriſh it, and contribute to Concoction; that it ſhould be endu'd with an acid or glandulous Ferment, or ſome corruptive Quality, for ſo ſpeedy a Diſſolution of the Meat and Preparation of Chyle; that after Concoction it ſhould have an Ability of contracting itſelf, and turning out the Meat.

That the *Guts* ſhould immediately receive it from the *Phylorus*, farther elaborate, prepare

pare and ſeparate it, driving by their periſtaltick Motion the Chyle into the Lacteals, and the excrementitious Parts to the Podex, from whence there is no Regreſs, unleſs when the Valve of the Colon is torn and relax'd. But for the curious Structure of theſe Parts ſee more in *Kerkringius*, *Gliſſon*, *Willis*, and *Preyer*.

That the Bladder ſhould be made of a membranous Subſtance, and ſo extremely dilatable, for receiving and containing the Urine till opportunity of emptying it; that it ſhould have Shuts for the Ends of the Ureters, ſo artificially contriv'd as to give the Urine free entrance, but to ſtop all Paſſage backward, ſo that they will not tranſmit the Wind, tho' it be ſtrongly blown and forc'd in.

That the *Liver* ſhould continually ſeparate the Choler from the Blood, and empty it into the Inteſtines, where there is good Uſe for it, not only to provoke Dejection, but alſo to attenuate the Chyle, and render it ſo ſubtile and fluid as to enter in at the Orifices of the lacteous Veins.

That in the *Kidneys* there ſhould be ſuch innumerable little Siphons or Tubes, conveying the urinous Particles to the Pelves and Ureters, firſt diſcover'd by *Bellini*, and illuſtrated by *Malpighi*; that indeed all the Glands of the *Body* ſhould be Congeries of various Sorts of Veſſels cur'd, circumgyrated and complicated together, whereby they give the Blood time to ſtop and ſeparate

thro' the Pores of the capillary Veſſels into the ſecretory ones, which afterwards all exonerate themſelves into one common *Ductus*; as may be ſeen in the Works of Dr. *Wharton*, *Graaf*, *Bartholine*, *Rudback*, *Bilſius*, *Malpighi*, *Nuck*, and others. That the Glands ſhould ſeparate ſuch Variety of Humours, all different in Colour, Taſte, Smell, and other Qualities.

Finally, That all the Bones, and all the Muſcles, and all the Veſſels of the Body, ſhould be ſo admirably contriv'd, and adapted, and compacted together for their ſeveral Motions and Uſes, and that moſt *geometrically*, according to the ſtricteſt Rules of *Mechanicks*; that if in the whole Body you change the Figure, Situation and Conjunction but of one Part, if you diminiſh or increaſe the Bulk and Magnitude; in fine, if you endeavour any Innovation or Alteration, you marr and ſpoil inſtead of mending; how can all theſe things put together but beget Wonder and Aſtoniſhment?

In the Muſcles alone there ſeems to be more Geometry than in all the artificial Engines in the World; and therefore the different Motions of Animals are a Subject fit only for the great Mathematicians to handle, amongſt whom *Steno*, Dr. *Croon*, and above all, *Alphonſo Borelli*, have made their Eſſays towards it.

That under one Skin there ſhould be ſuch infinite Variety of Parts, variouſly mingled, hard with ſoft, fluid with fix'd, ſolid with hollow, thoſe in Reſt with thoſe with Motion; ſome

with Cavities, as Morteſſes to receive, others with Tenons to fit thoſe Cavities, all theſe ſo pack'd and thruſt ſo cloſe together, that there is no unneceſſary Vacuity in the whole Body, and yet ſo far from claſhing or interfering one with another, or hindring each others Motions, that they do all friendly conſpire, all help and aſſiſt mutually one the other, all concur in one general End and Deſign, the Good and Preſervation of the whole, are certainly Arguments and Effects of infinite Wiſdom and Council; ſo that he muſt needs be worſe than mad that can find in his Heart to imagine all theſe to be caſual and fortuitous, or not provided and deſign'd by a moſt wiſe and intelligent Cauſe.

Every Part is cloath'd, join'd together and corroborated by Membranes, which upon ſeveral Occaſions (as Extravaſations of Humours, Compreſſions or Obſtructions of Veſſels) are capable of a prodigious Extenſion, as we ſee in the Hydatides of the Female Teſticles or Ovaries, in hydropical Tumors of the *Lymphæducts*, of the *Scrotum* or *Peritonæum*, out of the laſt of which alone twenty, and even forty Gallons of Water have been drawn by a *Paracenteſis*, or Tapping; for which we have the undoubted Authority of *Tulpius*, *Meekren*, *Pechlin*, *Blaſius*, and other medical Writers. What vaſt Sacks and Bags are neceſſary to contain ſuch a Collection of Water, which ſeems to iſſue from the *Lymphæducts*, either delacerated or obſtructed, and exonerating themſelves into the Foldings, or between the Duplicatures of the Membranes?

Thoſe Parts which one would think were of little Uſe in the Body, ſerving chiefly to fill up empty Spaces, as the Fat, if examin'd ſtrictly, will be found very beneficial and ſerviceable to it. 1. To cheriſh and keep it warm, by hindring the Evaporation of the hot Steams of Blood; as Cloaths keep us warm in Winter, by reflecting and doubling the Heat. 2. To nouriſh and maintain the Body for ſome time when Food is wanting, ſerving as Fuel to preſerve and continue the natural Heat of Blood, which requires an oily or ſulphurous *Pabulum* as well as Fire. Hence upon long Abſtinence and faſting the Body grows lean. Hence alſo ſome Beaſts, as the *Marmotto*, or *Mus Alpinus*, a Creature as big or bigger than a *Rabbet*, which abſconds all Winter, doth (as *Hildanus* tells us) live upon its own Fat; for in the *Autumn*, when it ſhuts itſelf up in its Hole (which it digs with its Feet like a Rabbet, making a Neſt with Hay or Straw to lodge itſelf warm) it is very fat; [*Hildanus* took out above a Pound and a half of Fat between the Skin and Muſcles, and a Pound out of the *Abdomen*] but on the contrary, in the Spring-time, when it comes forth again, very lean, as the Hunters experience in thoſe they then take. 3. The internal Fat ſerves for the Defence and Security of the Veſſels, that they might lie ſoft, and be ſafely convey'd in their Paſſage, wherefore it is eſpecially gather'd about them.

By what Pores, or Paſſages, or Veſſels, the Fat is ſeparated from the Blood when it is redundant,

and again abſorb'd into it when it is deficient, is a Matter of curious Enquiry, and worthy to be induſtriouſly ſought out by the moſt ſagacious and dextrous Anatomiſts. The Veſſels whereinto it is receiv'd, and wherein contain'd, are by the Microſcope detected to be Bladders, and thoſe doubtleſs perforated and pervious one into another; and tho' for their exceſſive Subtilty and Thinneſs they appear not in a lean Body, yet ſeem to have been primitively form'd and provided by Nature to receive the Fat upon occaſion. Why the Fat is collected chiefly about ſome particular Parts and Veſſels, and not others; as for Example, the Reins and the Caul, I eaſily conſent with *Galen* and others the Reaſon to be, the cheriſhing and keeping warm of thoſe Parts upon which ſuch Veſſels are ſpread; ſo the Caul ſerves for the warming the lower Belly, like an Apron or piece of woollen Cloth. Hence a certain Gladiator, whoſe Caul *Galen* cut out, was ſo liable to ſuffer from the Cold, that he was conſtrain'd to keep his Belly conſtantly cover'd with Wool; for the Inteſtines containing a great deal of Food, there to undergo its laſt Concoction, and no Veſſels of Blood penetrating it and flowing thro' it to keep it warm, they had need be defended from the Injuries of the external Air by outward Coverings. Why there ſhould be ſuch copious Fat gather'd about the Reins to incloſe them, is not ſo eaſy to diſcern, but ſurely there is a great and conſtant Heat requir'd there, for the Separation of the Urine from the Blood, the conſtant Sepa-

ration and Excretion whereof is neceſſary for the Preſervation of Life; and we ſee if the Blood be in any degree chill'd, the Secretion of Urine is in a great meaſure ſtopt, and the *Serum* caſt upon the Glandules of the Mouth and Throat; and if the Blood be extraordinarily heated by Exerciſe, or otherwiſe, it caſts off its *Serum* plentifully by Sweat, which may be effected by the ſwift motion of the Blood thro' the Glandules of the Skin, where its plentiful Streams being ſtrengthen'd and conſtipated into a Liquor, force their way thro' thoſe Emunctories, which at other times tranſmit only inſenſible Vapours. Some ſuch Effects may be wrought upon the Blood by the Heat of the Kidneys. Certain it is that the Humours excern'd by Sweat and Urine are near a-kin, if not the ſame; and therefore it is worthy the Conſideration, whether there might not be ſome Uſe made of ſweating in a Suppreſſion of Urine. But I digreſs too far.

I ſhall only add to this Particular, that becauſe the Deſign of Nature in collecting Fat in theſe places is for the fore-mention'd Uſe, it hath for the effecting thereof fitted the Veſſels there with Pores or Paſſages proper for the Separation and Tranſmiſſion of it.

I ſhould now proceed to treat of the Generation and Formation of the *Fœtus* in the Womb, but that is a Subject too difficult for me to handle, the Body of Man and other Animals being form'd

form'd in the dark Receſſes of the *Matrix*, or, as the *Pſalmiſt* phraſes it, *Pſal.* cxxxix. 14. *made in ſecret, and curiouſly wrought in the loweſt Parts of the Earth.* This Work is ſo admirable and unaccountable, that neither the Atheiſts nor mechanical Philoſophers have attempted to declare the Manner and Proceſs of it, but have (as I noted before) very cautiouſly and prudently broke off their Syſtems of natural Philoſophy here, and left this Point untouch'd; and thoſe Accounts which ſome of them have attempted to give of the Formation of a few of the Parts, are ſo exceſſively abſurd and ridiculous, that they need no other Confutation than *ha, ha, he.* And I have already farther ſhewn, that to me it ſeems impoſſible that Matter divided into as minute and ſubtle Parts as you will or can imagine, and thoſe mov'd according to what Catholick Laws ſoever can be devis'd, ſhould without the Preſidency and Direction of ſome intelligent Agent, by the mere Agitation of a gentle Heat, run itſelf into ſuch a curious Machine as the Body of Man is.

Yet muſt it be confeſs'd that the Seed of Animals is admirably qualify'd to be faſhion'd and form'd by the *Plaſtick Nature* into an organical Body, containing the Principles or component Particles of all the ſeveral homogeneous Parts thereof; for indeed every Part of the Body ſeems to club and contribute to the Seed, elſe why ſhould Parents that are born blind or deaf, or that want a Finger or any other Part, or have one ſu-

perfluous, ſometimes generate Children that have the ſame Defects or Imperfections; and yet (which is wonderful) nothing of the Body or groſſer Matter of the Seed comes near the firſt Principle of the *Fœtus*, or in ſome ſo much as enters the Womb, but only ſome contagious Vapour or ſubtle *Effluviums* thereof, which ſeems to animate the *Gemma* or *Cicatricula* of the Egg contain'd in the Female *Ovary* before it paſſes thro' the *Tubes* or *Cornua* into the *Uterus*. How far the Animalcules obſerv'd in the Seed of Males may contribute to Generation, I leave to the more ſagacious Philoſophers to enquire, and ſhall here content myſelf with referring the Reader to the ſeveral Letters publiſh'd by Mr. *Lewenhoek*.

But to what ſhall we attribute the *Fœtus* its Likeneſs to the Parents, or omitting them, to the precedent Progenitors; as I have obſerv'd, ſome Parents that have been both black hair'd, to have generated moſt red hair'd Children; becauſe their Anceſtors Hair hath been of that Colour? Or why are Twins ſo often extremely alike? Whether this is owing to the Efficient, or to the Matter?

Thoſe *Effluvia* we ſpake of in the Male Seed, as ſubtile as they are, yet have they a great, if not the greateſt Stroke in Generation, as is clearly demonſtrable in a Mule, which doth more reſemble the Male Parent, that is, the Aſs, than the Female, or Horſe. But now, why ſuch different

rent *Species* ſhould not only mingle together, but alſo generate an Animal, and yet that that hybridous Production ſhould not again generate, and ſo a new Race be carry'd on, but Nature ſhould ſtop here, and proceed no farther, is to me a Myſtery, and unaccountable.

One thing relating to Generation I cannot omit; that is, the Conſtruction of a Sett of temporary Parts (like Scaffolds in a Building) to ſerve a preſent End, which are afterwards laid aſide, afford a ſtrong Argument of Council and Deſign. Now for the Uſe of the Young during its Incloſure in the Womb there are ſeveral Parts form'd, as the Membranes inveloping it, call'd the *Secundines*, the umbilical Veſſels, one Vein, and two Arteries; the *Urachus*, to convey the Urine out of the Bladder, and the *Placenta Uterina*; part whereof fall away at the Birth, as the *Secundines* and *Placenta*; others degenerate into Ligaments, as the *Urachus*, and part of the umbilical Vein; beſides which, becauſe the *Fœtus* during its abode in the Womb hath no Uſe of Reſpiration by the Lungs, the Blood doth not all, I may ſay, not the greateſt part of it, flow thro' them, but there are two Paſſages or Channels contriv'd, one call'd the *Foramen Ovale*, by which part of the Blood brought by the *Vena Cava* paſſeth immediately into the Left Ventricle of the Heart, without entring the Right at all; the other is a large arterial Channel paſſing from the pulmonary Artery immediately into the *Aorta*, or great Artery, which

which likewise derives part of the Blood thither, without running at all into the Lungs; these two are clos'd up soon after the Child is born, when it breathes no more (as I may so say) by the *Placenta Uterina*, but Respiration by the Lungs is needful for it. It is here to be noted, that tho' the Lungs be form'd so soon as the other Parts, yet during the abode of the *Fœtus* in the Womb they lie by as useless. In like manner I have observ'd, that in ruminating Creatures the three foremost Stomachs, not only during the continuance of the Young in the Womb, but so long as it is fed with Milk, are unemploy'd and useless, the Milk passing immediately into the fourth.

Another Observation I shall add concerning Generation, which is of some moment, because it takes away some Concessions of Naturalists that give countenance to the Atheists fictitious and ridiculous Account of the first Production of Mankind and other Animals, *viz.* That all Sorts of Insects, yea, and some Quadrupeds too, as Frogs and Mice, are produc'd spontaneously. My Observation and Affirmation is, that there is no such thing in nature as æquivocal or spontaneous Generation, but that all Animals, as well small as great, not excluding the vilest and most contemptible Insect, are generated by animal Parents of the same *Species* with themselves; that noble *Italian* Virtuoso *Francisco Redi* having experimented, that no putrify'd Flesh (which one would think were the most likely of any thing) will

will of itſelf, if all Inſects be carefully kept from it, produce any. The ſame Experiment I remember Dr. *Wilkins*, late Biſhop of *Cheſter*, told me had been made by ſome of the *Royal Society*. No Inſtance againſt this Opinion doth ſo much puzzle me as Worms bred in the Inteſtines of Man and other Animals. But ſeeing the round Worms do manifeſtly generate, and probably the other Kinds too, it is likely they come originally from Seed, which, how it was brought into the Guts, may afterwards poſſibly be diſcover'd. Moreover, I am inclinable to believe that all Plants too, that themſelves produce Seed (which are all but ſome very imperfect ones, which ſcarce deſerve the Name of Plants) come of Seed themſelves. For the great Naturaliſt *Malpighius*, to make Experiment whether Earth would of itſelf put forth Plants, took ſome purpoſely digg'd out of a deep place and put it into a Glaſs Veſſel, the top whereof he cover'd with Silk many times doubled, and ſtrain'd over it, which would admit the Water and Air to paſs thro', but exclude the leaſt Seed that might be wafted by the Wind; the Event was, that no Plant at all ſprang up in it. Nor need we wonder how in a Ditch, Bank or Graſs-plat newly digg'd, or in the Fen-Banks in the *Iſle of Ely*, Muſtard ſhould abundantly ſpring up, where in the Memory of Man none hath been known to grow, for it might come of Seed which had lain there more than a Man's Age, ſome of the Antients mentioning ſome Seeds that retain their Fecundity forty Years; and I have

have found in a Paper receiv'd from a Friend, but whom I have forgotten, that Melon-Seeds after thirty Years are beſt for raiſing of Melons. As for the Muſtard that ſprung up in the *Iſle of Ely*, tho' there had never been any in that Country, yet might it have been brought down in the Channels by the Floods, and ſo being thrown up the Banks together with the Earth, might germinate and grow there.

And indeed a ſpontaneous Generation of Animals and Plants, upon due Examination, will be found to be nothing leſs than a Creation of them; for after the Matter was made, and the Sea and dry Land ſeparated, how is the Creation of Plants and Animals deſcrib'd, but by a commanding, that is, effectually cauſing the Waters and Earth to produce their ſeveral Kinds without any Seed? Now Creation being the Work of Omnipotency, and incommunicable to any Creature, it muſt be beyond the Power of Nature or natural Agents to produce Things after that manner. And as for God Almighty, he is ſaid to have reſted from his Work of Creation after the ſeventh Day. But if there be any ſpontaneous Generation, there was nothing done at the Creation but what is daily done; for the Earth and Water produc'd Animals then without Seed, and ſo they do ſtill.

Becauſe ſome, I underſtand, have been offended at my confident Denial of all ſpontaneous Generation, accounting it too bold and groundleſs, I ſhall

I ſhall a little enlarge upon it, and give my Reaſons, in order to their Satisfaction.

Firſt, Then, I ſay, ſuch a ſpontaneous Generation ſeems to me to be nothing leſs than a Creation; for Creation being not only a Production of a thing out of nothing, but alſo out of indiſpos'd Matter, as may be clearly inferr'd from the Scripture, and is agreed by all Divines, this ſpontaneous Generation being ſuch a Production, wherein doth it differ from Creation? Or what did God Almighty do at the firſt Creation of Animals and Plants more than what (if this be true) we ſee every Day done? To me, I muſt confeſs, it ſeems almoſt demonſtrable, that whatever Agent can introduce a Form into indiſpos'd Matter, or diſpoſe the Matter in an Inſtant, muſt be ſuperior to any natural one, not to ſay omnipotent.

Secondly, Thoſe who have with the greateſt Diligence and Application conſider'd and ſearch'd into this Matter, as thoſe eminent Virtuoſi, *Marcellus Malpighius*, *Franciſcus Redi*, *John Swammerdam*, *Lewenhoek*, and many others, are unanimouſly of this Opinion, ſave that *Franciſcus Redi* would except ſuch Inſects as are bred in Galls, and ſome other Excreſcencies of Plants. Now their Authority weighs more with me than the general Vogue, or the concurrent Suffrages of a thouſand others, who never examin'd the thing ſo carefully and circumſpectly as they have done,

done, but run away with the Cry of the common Herd of Philosophers.

First of all, Dr. *Swammerdam*, who hath been, to the best Purpose of any Man I know of, busy'd in searching out and observing the Nature of all Insects in general; all in general I say, for as to one particular Insect, to wit, the Silk-Worm, I must except Signior *Malpighi*; and to one *Genus* of them, to wit, Spiders, Dr. *Lister*, in his general History of Insects, written in *Low Dutch*, and translated into *French*, p. 47. hath these Words, *Nous disons qu'il ne se fait dans toute la nature aucune generation par accident*, &c. *We affirm that there is not in all Nature any accidental* [*or spontaneous*] *Generation, but all come by Propagation; wherein Chance hath not the least Part or Interest.* And in *p.* 159. speaking of the Generation of Insects out of Plants, in Contradiction I suppose to Signior *Redi*, he saith, *Nous croyons absolument*, &c. *We do absolutely believe that it is not possible to prove by Experience that any Insects are engender'd out of Plants; but on the contrary, we are very well inform'd and assur'd, that these little Animals are not shut up in or inclos'd there for any other reason than to draw thence their Nourishment.* It is true indeed, that by a certain, constant, and immutable Order of Nature, we see many Sorts of Insects affix'd to particular *Species* of Plants and Fruits, to which the respective Kinds fasten themselves as it were by Instinct;

ſtinct; but we are to know that they all come of the Seed of Animalcules of their own Kind, that were before laid there; for theſe Inſects do thruſt their Seed or Eggs ſo deep into the Plants, that they come to be afterwards as it were united with them, and the Aperture or Orifice by which they enter'd quite clos'd up and obliterated, the Eggs being hatch'd and nouriſh'd within. We have often found the Eggs of Inſects ſo deeply ſunk into the tender Buds of Trees, that without hurting of them it was impoſſible to draw them out. Many Inſtances he produces in ſeveral Sorts of Inſects making their way into Plants, which, tho' they be well worth the reading, are too long to tranſcribe.

Secondly, That great and ſagacious Naturaliſt, and moſt accurate Examiner of theſe Things, Signior *Malpighi*, in his Treatiſe of *Galls*, under which Name he comprehends all preternatural and morboſe Tumours and Excreſcencies of Plants, doth demonſtrate in particular, that all ſuch Warts, Tumours and Excreſcencies, where any Inſects are found, are excited or rais'd up either by ſome venenoſe Liquor, which together with their Eggs ſuch Inſects ſhed upon the Leaves, or Buds, or Fruits of Plants, or boring with their *Terebræ*, inſtil into the very Pulp of ſuch Buds or Fruits; or by the contagious Vapour of the very Eggs themſelves, producing a Mortification or Syderation in the Parts of Plants on which they

are

are laid; or lastly, by the Grubs or Maggots hatch'd of the Eggs laid there, making their way with their Teeth into the Buds, Leaves or Fruit, or even the Wood itself of such Plants on which their Eggs were laid. So that at the last he concludes: *Erunt itaque Gallæ & reliqui plantarum tumores morbosæ excrescentiæ, vi depositi ovi à turbata plantarum compage, & vitiato humorum motu excitatæ, quibus inclusa ova & animalcula velut in utero foventur & augentur, donec manifestatis firmatisque propriis partibus, quasi exoriantur novam exoptantia auram. We conclude therefore that Galls, and other Tumors of Plants, are nothing else but morbose Excrescencies, rais'd up by the Force of the Eggs there laid, disturbing the Vegetation and Temper of the Plants, and perverting the Motion of their Humours and Juices; wherein the inclos'd Eggs and Animalcules are cherish'd, nourish'd, and augmented, till their proper Parts being manifested, explicated, and harden'd, or strengthen'd, they are as it were new born, affecting to come forth into the open Air.* In the same Treatise he describes the hollow Instrument *(Terebra* he calls it, and we may *English* it *Piercer)* wherewith many Flies are provided, proceeding from the Womb, with which they perforate the Teguments of Leaves, Fruits, or Buds, and through the Hollow of it inject their Eggs into the Holes, or Wounds which they have made, where in process of Time they are hatch'd and nourish'd.

This

This he beheld one of these Insects doing with his own Eyes in the Bud of an Oak; the manner whereof he describes, *p.* 47. which I shall not transcribe, only take notice, that when he had taken off the Insect he found in the Leaf very little and diaphanous Eggs, exactly like to those which yet remain'd in the Tubes of the Fly's Womb. He adds farther, that it is probable that there may be Eggs hidden in divers Parts of Plants, whereof no Footstep doth outwardly appear, but the Plant remains as entire and thrives as well as if there were no Insect there; nay, that some may be hidden and cherish'd in dry Places (not wanting any Humour to feed them) as in Sear-Wood, yea, in Earthen Vessels, and Marbles themselves.

Indeed to me it seems unreasonable that Plants, being of a lower Form or Order of Being, should produce Animals; for either they must do it out of indispos'd Matter, and then such Production would amount to a Creation, or else they must prepare a fit Matter, which is to act beyond their Strength, there being requir'd to the Preparation of the Sperm of Animals a great *Apparatus* of Vessels, and many Secretions, Concoctions, Reflections, Digestions and Circulations of the Matter, before it can be rectify'd and exalted into so noble a Liquor; and besides, there must be an Egg too; for we know *ex ovo omnia*; to the Perfection whereof there are as many Vessels and as long a Process requir'd. Now in Plants there are

no such Vessels, and consequently no such Preparation of Eggs or Sperm, which are the necessary Principles of Animals.

Thirdly, That worthy Author of our own Country, I mean Dr. *Lister*, in his Notes upon *Geodartius Insect. Numb.* 16. *p.* 47. hath these Words: *Non enim inducor ut credam, hoc, vel aliud quodvis Animal, modo quodam spontaneo è Planta produci, & alii causæ cuicunque originem suam debere quàm Parenti Animali*; i. e. *I cannot be perswaded or induc'd to believe, that this, or any other Animal, is (or can be) produc'd out of a Plant in a spontaneous manner, or doth owe its Original to any other Cause whatever, than an Animal Parent of its own Kind.* And in his third Note upon *Insect. Numb.* 49. these: *Quoad spontaneam Erucæ hujus aliorumque Insectorum generationem, pro parte negativa jam sententiam meam tradidi*, &c. *As to the spontaneous Generation of this* Eruca, *and other Insects, I have already deliver'd my Opinion for the Negative. This is most certain, that these* Cossi *are produc'd of Eggs laid by Animal Parents: It is also alike clear, that these diminutive Caterpillars are able by degrees to pierce or bore their way into a Tree; which very small Holes, after they are fully enter'd, do perchance grow together, and quite disappear, at least become so small, that they are not to be discern'd, unless by* Lynceus's *Eyes. Add moreover, that perchance they undergo no Transformation, but continue under the Vizard of* [Erucæ] *Caterpillars for many Years, which doth very well accord*

accord with my Observations. Moreover, that this Caterpillar [Eruca] *is propagated by Animal Parents, to wit, Butterflies, after the common Origination of all Caterpillars.* In all this I fully consent with the Doctor, only crave Leave to differ in his attributing to them the Name of *Cassi* which were accounted by the Antients a delicate Morsel, and fed for the Table; for I take those to have been the Hexapods, from which the greater Sort of Beetles come; for that that Sort of Hexapods are at this Day eaten in our *American* Plantations, as I am inform'd by my good Friend Dr. *Hans Sloane*, who also presented me with a Glass of them preserv'd in Spirit of Wine.

Having lately had an Opportunity more curiously to view and examine the great Flesh-colour'd, thin-hair'd, *English* Caterpillar (which is so like that sent me by Dr. *Sloane*, that it differs little but in Magnitude, which may be owing to the Climate) I observ'd that it had a Power of drawing its eight hind Legs or Stumps so far up in its Body that they did altogether disappear, so that the Creature seem'd to want them, and of thrusting them out again at pleasure; whereupon I conjectur'd, that that Insect of *Jamaica* sent me by the Doctor (which I took to be the *Cossus* or *Hexapod*, previous to some large Beetle) had likewise the same Power of drawing up its hind Legs, so that tho' to appearance it wanted them, yet really it did not so, but had only drawn them up and hid them in its Body when it was im-

mers'd in the Spirit of Wine, and consequently was not the *Hexapod* of a Beetle, but an *Eruca*, like to, or indeed specifically the same with that of our own Country by me observ'd; and being eaten at this Day by the Inhabitants of *Jamaica*, is in all likelihood the same with the *Cossus* of the antient *Romans*, which was fed for the Table, as *Pliny* assures us; especially if we consider, that Dr. *Lister* found this *Eruca* in the Body of an Oak newly cut down and saw'd in pieces; on which Tree *Pliny* saith they feed. Thus much I thought fit to add to Dr. *Lister*, and do the Truth right, by retracting my former Conjecture concerning the *Cossi*.

3. My third Argument against spontaneous Generation is, because there are no Arguments or Experiments which the Patrons of it do or can produce which do clearly evince it. For the general and vulgar Opinion, that the Heads of Children, or the Bodies of those that do not change their Linnen, but wear that which is sweaty and sordid, breeds Lice; or that Cheese of itself breeds Mites or Maggots; I deny, and look upon it as a great Error and Mistake; and do affirm, that all such Creatures are bred of Eggs laid in such sordid Places by some wandring Louse, or Mite, or Maggot; for such Places being most proper for the hatching and exclusion of their Eggs, and for the Maintenance of their Young, Nature hath endu'd them with a wonderful Acuteness of Scent and Sagacity, whereby they can, tho' far

distant, find out and make towards them; and even Lice and Mites themselves, as slow as they seem to be, can, to my Knowledge, in no long time march a considerable way to find out a convenient Harbour for themselves.

Here, by the by, I cannot but look upon the strange Instinct of this noisome and troublesome Creature a Louse, of searching out foul and nasty Clothes to harbour and breed in, as an Effect of divine Providence, design'd to deter Men and Women from Sluttishness and Sordidness, and to provoke them to Cleanliness and Neatness. God himself hateth Uncleanliness, and turns away from it, as appears by *Deut.* xxiii. 12, 13, 14. But if God requires and is pleas'd with bodily Cleanliness, much more is he so with the Pureness of the Mind. *Blessed are the pure in Heart, for they shall see God,* Matth. v. 10.

As for the Generation of Insects ont of putrid Matter, the Experiments of *Franciscus Redi,* and some of our own *Virtuosi,* give me sufficient reason to reject it. I did but just now mention the quick Scent that Insects have, and the great Sagacity in finding out a proper and convenient Harbour or *Matrix* to cherish and hatch their Eggs and feed their Young; they are so acted and directed by Nature, as to cast their Eggs in such Places as are most accommodated for the Exclusion of their Young, and where there is Food ready for them as soon as they be hatch'd; nay, it is a very hard matter to keep off such Insects

from ſhedding their Seed in ſuch proper Places. *Indeed if an Inſect may be thus equivocally generated, why not ſometimes a Bird, a Quadruped, a Man, or even an Univerſe? Or, why no new Species of Animals now and then? As my learned Friend Dr.* Tancred Robinſon *very well argues in his Letters; for there is as much Art ſhewn in the Formation of thoſe as of theſe.*

A fourth and moſt effectual Argument againſt ſpontaneous Generation is, that there are no new Species produc'd, which would certainly now and then, nay, very often happen were there any ſuch thing; for in ſuch pretended Generations, the generant or active Principle is ſuppos'd to be the Sun, which being an inanimate Body, cannot act otherwiſe than by his Heat, which Heat can only put the Particles of the paſſive Principle into motion; the paſſive Principle is putrid Matter, the Particles whereof cannot be conceiv'd to differ in any thing but Figure, Magnitude and Gravity; now the Heat putting theſe Particles in motion, may indeed gather together thoſe which are homogeneous, or of the ſame nature, and ſeparate thoſe that are heterogeneous, or of a different, but that it ſhould ſo ſituate, place and connect them as we ſee in the Bodies of Animals, is altogether inconceivable; which if it could, yet that it ſhould always run them into ſuch a Machine as is already extant, and not often into ſome new-faſhion'd one, ſuch as was never ſeen before, no Reaſon can be aſſign'd or imagin'd. This the *Epicurean* Poet *Lucretius* was ſo ſenſible of, that he

he saw a necessity of granting Seeds or Principles to determine the Species. For (saith he) if all Sorts of Principles could be connected,

——— *Vulgo fieri portenta videres,*
Semiferas hominum species existere, & altos
Interdum ramos egigni corpore vivo;
Multàque connecti terrestria membra marinis;
Tum flammam retro spirantes ore chimæras
Pascere naturam per terras omniparenteis
Quorum nil fieri manifestum est, omnia quando
Seminibus certis, certa genetrice, creata
Conservare genus crescentia posse videmus, &c.

That is ——— *Thence would rise*
Vast Monsters, Nature's great Absurdities;
Something half Beast, half Man, and some would grow
Tall Trees above, and Animals below,
Some join'd of Fish and Beasts, and every where
Frightful Chimæra's *breathing Flames appear.*
But since we see no such, and Things arise
From certain Seeds, of certain Shape and Size,
And keep their Kind as they increase and grow,
There's some fix'd Reason why it should be so.

The raining of Frogs, and their Generation in the Clouds, tho' it may be attested by many and great Authors, I look upon as utterly false and ridiculous; it seems to me no more likely that Frogs should be engender'd in the Clouds, than *Spanish* Gennets begotten by the Wind, for that hath good Authors too; and he that can swallow the raining of Frogs, hath made a fair Step to-

wards believing that it may rain Calves alſo, for we read that one fell out of the Clouds in *Avicen*'s Time; nor do they much help the matter, who ſay, that thoſe Frogs that appear ſometimes in great Multitudes after a Shower, are not indeed engender'd in the Clouds, but coagulated of a certain ſort of Duſt commix'd and fermented with Rain-Water; to which Hypotheſis *Fromondus* adheres.

But let us a little conſider the Generation of Frogs in a natural way. 1. There are two different Sexes, which muſt concur to their Generation. 2. There is in both a great *Apparatus* of ſpermatick Veſſels, wherein the nobler and more ſpirituous Part of the Blood is by many Digeſtions, Concoctions, Reflections and Circulations exalted into that generous Liquor we call Sperm; and likewiſe for the preparing of the Eggs. 3. There muſt be a Copulation of the Sexes, which I rather mention becauſe it is the moſt remarkable in this that ever I obſerv'd in any Animal; for they continue in *complexu venereo* at leaſt a Month indefinitely, the Male all that while reſting on the Back of the Female, clipping and embracing her with his Legs about the Neck and Body, and holding her ſo faſt, that if you take him out of the Water he will rather bear her whole Weight than let her go; this I obſerv'd in a Couple kept on purpoſe in a Veſſel of Water by my learned and worthy Friend Mr. *John Nid*, Fellow of *Trinity-College*, long ſince deceas'd; after this the Spawn muſt be caſt into Water, where the Eggs lie

lie in the midſt of a copious Jelly, which ſerves them for their firſt Nouriſhment for a conſiderable while; and at laſt the Reſult of all is not a perfect Frog, but a Tadpole, without any Feet, and having a long Tail to ſwim withal; in which Form it continues a long time, till the Limbs be grown out and the Tail fallen away, before it arrives at the Perfection of a Frog.

Now if Frogs can be generated ſpontaneouſly in the Clouds out of Vapour, or upon the Earth out of Duſt and Rain-Water, what needs all this a-do? To what purpoſe is there ſuch an *Apparatus* of Veſſels for the Elaboration of the Sperm and Eggs? ſuch a tedious Proceſs of Generation and Nutrition? This is but an idle Pomp; the Sun (for he is ſuppos'd to be the equivocal Generant or Efficient by theſe Philoſophers) could have diſpatch'd the Buſineſs in a Trice; give him but a little Vapour, or a little dry Duſt and Rain-Water, he will produce you a quick Frog, nay, a whole Army of them, perfectly form'd, and fit for all the Functions of Life, in three Minutes, nay, in the hundredth Part of one Minute, elſe muſt ſome of thoſe Frogs that were generated in the Clouds fall down half form'd and imperfect, which I never heard they did; and the Proceſs of Generation have been obſerv'd in the Production of Frogs out of Duſt and Rain-Water, which no Man ever pretended to mark or diſcern. But that there can be no Frogs generated in the Clouds, may further be made appear, 1. From the

the extreme Cold of the middle Region of the Air, where the Vapours are turn'd into Clouds, which is not at all propitious to Generation; for did not so great Men as *Aristotle* and *Erasmus* report it, I could hardly be induc'd to believe that there could be one *Species* of Insects generated in Snow. 2. Because if there were any Animals engender'd in the Clouds, they must needs be maim'd and dash'd in pieces by the Fall, at least such as fell in the High-ways and upon the Roofs of Houses; whereas we read not of any such broken or imperfect Frogs found any where. This last Argument was sufficient to drive off the learned *Fromondus* from the Belief of their Generation in the Clouds; but the Matter of Fact he takes for granted, I mean, the spontaneous Generation of Frogs out of Dust and Rain-Water, from an Observation or Experiment of his own at the Gates of *Tournay* in *Flanders*, to the Sight of which Spectacle he call'd his Friends who were there present, that they might admire it with him. *A sudden Shower* (saith he) *falling upon the very dry Dust, there suddenly appear'd such an Army of little Frogs, leaping about every where upon the dry Land, that there was almost nothing else to be seen; they were also of one Magnitude and Colour; neither did it appear out of what lurking Places* [Latibula] *so many Myriads could creep out, and suddenly discover themselves upon the dry and dusty Soil, which they hate.* But saving the Reverence due to so great a Man, I doubt not but they did all creep out of their Holes and Coverts, invited

vited by the agreeable Vapour of the Rain-Water; this, however unlikely it may ſeem, is a thouſand times more probable than their inſtantaneous and undiſcernible Generation out of a little dry Duſt and Rain-Water, which alſo cannot have any time to mix and ferment together, which is the *Hypotheſis* he adheres to; nay, I affirm, that it is not at all improbable; for he that ſhall walk out in Summer Nights, when it begins to grow dark, may obſerve ſuch a Multitude of great Toads and Frogs crawling about in the High-ways, Paths and Avenues to Houſes, Yards, and Walks of Gardens and Orchards, that he will wonder whence they came, or where they lurk'd all the Winter and all the Day-time, for that then it is a rare thing to find one.

To which add, that in ſuch Frogs as we are ſpeaking of, Monſieur *Perault* hath upon Diſſection often found the Stomach full of Meat, and the Inteſtines of Excrement; whence he juſtly concludes, "that they were not then firſt form'd, "but only appear'd of a ſudden; which is no "great Wonder, ſince upon a Shower after a "Drought, Earth-worms and Land-Snails innu-"merable come out of their lurking Places in "like manner.

In Confirmation of what I have here written againſt the ſpontaneous Generation of Frogs, either in the Clouds out of Vapour, or on the Earth out of Duſt and Rain-Water commix'd, endeavouring

vouring to prove by Force of Argument that there is no such thing, I have lately receiv'd from my learned and ingenious Friend Mr. *William Derham*, Rector of *Upminster*, near *Rumford* in *Essex*, a Relation parallel to that of *Fromondus*, concerning the sudden Appearance of a vast Number of Frogs, after a Shower or two of Rain, marching cross a sandy Way, that before the Rain was very dusty, and giving an Account where, in all likelihood, they were generated by Animal Parents of their own Kind, and whence they did proceed. The whole Narrative I shall give the Reader in his own Words.

Some Years ago, as I was riding forth one Afternoon in Berks, *I happen'd upon a prodigious Multitude creeping cross the Way; it was a sandy Soil, and the Way had been full of Dust, by reason of a dry Season that then was; but an Hour or two before a refreshing fragrant Shower or two of Rain had laid the Dust; whereupon what I had heard or read of the raining of Frogs, immediately came to my Thoughts, as it easily might do, there being probably as good reason then for me, as I believe any ever had before, to conclude that these came from the Clouds, or were instantaneously generated; but being prepossess'd with the contrary Opinion,* viz. *that there was no equivocal Generation, I was very curious in enquiring whence this vast Colony might probably come; and upon searching I found two or three Acres of Land cover'd with this black Regiment, and that they all march'd the same way towards some*

some Woods, Ditches, and such like cool Places in their Front, and from large Ponds in their Rear; I trac'd them backwards, even to the very side of one of the Ponds; these Ponds in spawning-time always us'd to abound much with Frogs, whose croaking I have heard at a considerable distance; and a great deal of Spawn I have found there.

From these Circumstances I concluded that this vast Colony was bred in those Ponds, from whenceward they steer'd their Course; that after their Incubation (if I may so call it) or hatching by the Sun, and their having pass'd their Tadpole State, they had liv'd (till that time of their Migration) in the Waters, or rather on the Shore, among the Flags, Rushes, and long Grass; but now being invited out by the refreshing Showers, then newly fallen, which made the Earth cool and moist for their March, that they left their old Latibula, *where perhaps they had devour'd all their proper Food, and were now in pursuit of Food, or a more convenient Habitation.*

This I think not only reasonable to be concluded, but withal so easy to have been discover'd by any inquisitive Observer, who in former Times met with the like Appearance, that I cannot but admire that such sagacious Philosophers as Aristotle, Pliny, *and many other since, should ever imagine Frogs to fall from the Clouds, or be any way instantaneously or spontaneously generated, especially considering how openly they act their Coition, produce Spawn, this Spawn Tadpoles, and Tadpoles Frogs.*

Neither

Neither in Frogs only, but alſo in many other Creatures, as Lice, Fleſh-Flies, Silk-Worms, and other Papilio's, *an uniform regular Generation was very obvious, which is an Argument to me of a ſtrange Prepoſſeſſion of Fancy in the Ages ſince* Ariſtotle, *not to ſay of Careleſſneſs and Sloth.* So far Mr. *Derham.*

In like manner doubtleſs *Fromondus*, had he made a diligent Search, might have found out the Place where thoſe Myriads of Frogs, obſerv'd by him about the Gates of *Tournay*, were generated, and whence they did proceed.

As for the Worms and other Animals bred in the Inteſtines of Man and Beaſt, I have declar'd myſelf not to be ſatisfy'd of the Ways and Means how their Seeds come to be convey'd into thoſe Places, but yet that their Generation is analogous to that of other Creatures of thoſe Kinds, I doubt not; the Conſtancy to their *Species*, their exact Agreement and perpetual Similitude in the Shape and Figure of their Bodies and all the Parts, their Conſiſtence, Temper, Motion, and other Accidents, are to me little leſs than a Demonſtration that they are not the Effects of Chance, but the Products of a ſettled and ſpermatick Principle; I am at preſent, till better inform'd, of opinion that their Eggs are ſwallow'd with the Meat we eat; and I am the rather induc'd to think ſo, becauſe Children in their firſt Infancy, and as

long as they are constantly confin'd to a Milk Diet, are seldom troubled with them.

After this was written I receiv'd a Letter from my often remember'd ingenious Friend Dr. *Tancred Robinson* referring to this Matter, part whereof I shall transcribe, as being very pertinent, instructive, and consonant to my own Thoughts. *I think it may be prov'd, that the vast Variety of Worms found in almost all the Parts of different Animals, as well* terrestrial *as* aquatick, *are taken into their respective Bodies by Meats and Drinks, and there either lie still for some time, or else grow and alter by change of Place and Food* [*not specifically, but accidentally, in Magnitude, Colour, Figure of some Parts, or the like.*] *We know as yet but little of the numerous* Insects *bred in Water, or indeed of those in Roots, Leaves, Buds, Flowers, Fruits and Seeds, which we are continually swallowing, and these too all vary according to Climate* [*that is, the same Species of* Roots, Leaves, *&c. do in different Climates produce many different Species of Insects, tho' some there be common to all*] *the long slender Worms, as small as Hairs, that breed between the Skin and the Flesh in the Isle of* Ormuz, *and in* India, *which are generally twisted out upon Sticks or Rowlers, and often break in the Operation, are without doubt taken in by the Water they drink in those Regions, as I could prove by many and good Experiments had I Time. They who have Leisure may find them in the Collections of Voyages and Travels, especially in Monsieur* Thevenot. *By this Explication*

Explication we may give a better Account of the Vomitings-up of Tadpoles, Snails, and other Animals, recorded in medical Hiſtories, than by any Hypotheſis of equivocal Generation. As to Inſects found in ſtinking Fleſh or rotten Vegetables, I could never obſerve or find any of them different from thoſe Parent-Inſects which hover about or feed upon ſuch Bodies.

If any ſhall object the infinite Multitudes of Animalcules diſcover'd in Pepper-Water, and deſire an Account of their Generation; to him I ſhall ſay, that it is probable that ſome few of theſe Animals may be floating in all Waters, and that finding the Particles of Pepper ſwimming in the Water, very proper for the cheriſhing and excluding of their Eggs, by reaſon of their Heat, or ſome other unknown and ſpecifick Quality, they may faſten their Eggs to them, and ſo there may be a ſudden Breed of infinite Swarms of them; but theſe being not to be diſcern'd by the moſt piercing and *Lyncean* Sight without the Aſſiſtance of a Microſcope, I leave the Manner of their Generation to future Diſcovery.

No leſs difficult is it to give an Account of the Original of ſuch Inſects as are found, and ſeem to be bred in the Bodies of others of different Kinds. Out of the Sides and Back of the moſt common Caterpillar, which feeds upon Cabbage, Cole-wort, and Turnep-Leaves,

Leaves, which we have deſcrib'd in the Catalogue of *Cambridge Plants*, we have ſeen creep out ſmall Maggots to the Number ſometimes of Threeſcore or more, which ſo ſoon as ever they came forth began to weave themſelves ſilken Caſes of a yellow ſhining Colour, wherein they chang'd, and after ſome time came out thence in the form of ſmall Flies with four Wings; for a full Deſcription and Hiſtory whereof I ſhall refer the Reader to the fore-mention'd Catalogue. The like I have alſo obſerv'd in other Caterpillars of a different Kind, which have produc'd no leſſer Number of Maggots, that in like manner immediately made themſelves up in Caſes. Others, inſtead of changing into *Aurelia's*, as in the uſual Proceſs of Nature they ought to do, have turn'd into one, two, or three, or more Fleſh-Fly-Caſes, at leaſt contain'd ſuch Caſes within them, out of which after a while were excluded Fleſh-Flies. Other Caterpillars, as that call'd the *ſolitary Maggot*, found in the dry Heads of Teaſel, by a dubious *Metamorphoſis*, ſometimes chang'd into the *Aurelia* of a Butterfly, ſometimes into a Fly-Caſe. You'll ſay, how comes this to paſs? Muſt we not here neceſſarily have recourſe to a ſpontaneous Generation? I anſwer, No; the moſt that can be inferr'd from hence is, a Tranſmutation of *Species*; one Inſect may, inſtead of generating another of its own Kind, beget one or more of a different; but I can by no means grant this; I do believe that theſe Flies do either caſt their Eggs upon the very Bodies of the fore-mention'd Caterpillars,

or upon the Leaves on which they feed, all in a String; which there hatching, eat their way into the Body, where they are nouriſh'd till they be come to their full Growth; or it may be the Fly may with the hollow and ſharp Tube of her Womb punch and perforate the very Skin of the *Eruca*, and caſt her Eggs into its Body; ſo the *Ichneumon* will convey her Eggs into Caterpillars.

The Diſcovery of the Manner of the Generation of theſe Sorts of Inſects I earneſtly recommend to all ingenious Naturaliſts as a Matter of great moment; for if this Point be but clear'd, and it be demonſtrated that all Creatures are generated univocally by Parents of their own Kind, and that there is no ſuch thing as ſpontaneous Generation in the World, one main Prop and Support of Atheiſm is taken away, and their ſtrongeſt Hold demoliſh'd; they cannot then exemplify their fooliſh *Hypotheſis* of the Generation of Man and other Animals at firſt by the like of Frogs and Inſects at this preſent Day.

It will be farther objected that there have live Toads been found in the midſt of Timber Trees, nay, of Stones when they have been ſawn aſunder.

To this I anſwer, that I am not fully ſatisfy'd of the Matter of Fact; I am ſo well acquainted with the Credulity of the Vulgar, and the Delight they, and many of the better Sort too, have in telling of Wonders and ſtrange things, that I muſt

have a thing well atteſted before I can give a firm Aſſent to it.

Since the writing hereof the Truth of theſe Relations, of live Toads found in the midſt of Stones, hath been confirm'd to me by ſufficient and credible Eye-witneſſes, who have ſeen them taken out; ſo that there is no doubt of the Matter of Fact.

But yet, ſuppoſe it be true, it may be accounted for; thoſe Animals when young and little finding in the Stone ſome ſmall Hole reaching to the middle of it, might, as their nature is, creep into it, as a fit *Latibulum* for the Winter, and grow there too big to return back by the Paſſage by which they enter'd, and ſo continue impriſon'd therein for many Years, a little Air, by reaſon of the Coldneſs of the Creature, and its lying torpid there, ſufficing it for Reſpiration; and the Humour of the Stone, by reaſon it lay immoveable, and ſpent not, for Nouriſhment; and I do believe that if thoſe who found ſuch Toads had diligently ſearch'd, they might have diſcover'd and trac'd the way whereby they enter'd in, or ſome Footſteps of it; or elſe there might fall down into the lapideous Matter, before it was concrete into a Stone, ſome ſmall Toad (or ſome Toad-Spawn) which being not able to extricate itſelf and get out again, might remain there impriſon'd till the Matter about it were condens'd and compacted into a Stone; but however it

came there, I dare confidently affirm it was not there ſpontaneouſly generated; for elſe either there was ſuch a Cavity in the Stone before the Toad was generated, which is altogether improbable, and *gratis dictum*, aſſerted without any ground, or the Toad was generated in the ſolid Stone, which is more unlikely than the other, in that the ſoft Body of ſo ſmall a Creature ſhould extend itſelf in ſuch a Priſon, and overcome the Strength and Reſiſtance of ſuch a great and ponderous Maſs of ſolid Stone.

And whereas the Aſſertors of equivocal Generation were wont to pretend the Imperfection of theſe Animals as a ground to facilitate the Belief of their ſpontaneous Generation, I do affirm that they are as perfect in their Kind, and as much Art ſhewn in the Formation of them as of the greateſt, nay, more too in the Judgment of that great Wit and natural Hiſtorian * *Pliny*. *In magnis ſiquidem corporibus* (ſaith he) *aut certè majoribus facilis officina ſequaci materia fuit; in his tam parvis atque tam nullis, quæ ratio, quanta vis, quam inextricabilis perfectio?* In the greater Bodies the Forge was eaſy, the Matter being ductil and ſequacious, obedient to the Hand and Stroke of the Artificer, apt to be drawn, form'd or moulded into ſuch Shapes and Machines even by clumſy Fingers; but in the Formation of theſe, ſuch diminutive Things, ſuch Nothings, what Cunning and Curioſity! what Force and Strength

* Lib. 11. cap. 2.

was requiſite, there being in them ſuch inextricable Perfection!

To what Proofs or Examples of ſpontaneous Generation may be brought from Inſects bred in the Fruits or Excreſcencies of Plants, I have already made anſwer in my ſecond Particular, which contains the Teſtimonies of our beſt modern Naturaliſts concerning theſe Things.

In my Denial of the ſpontaneous Generation of *Plants*, I am not ſo confident and peremptory, but yet there are the ſame Objections and Arguments againſt it as againſt that of Animals, *viz.* becauſe it would be a Production out of indiſpos'd Matter, and conſequently a Creation; or if it be ſaid there is diſpos'd Matter, prepar'd by the Earth, or Sun, the Heat, or whatever other Agent you can aſſign; I reply, this is to make a thing act beyond its Strength, that is, an inferior Nature, which hath nothing of Life in it, to prepare Matter for a ſuperior, which hath ſome degree of Life, and for the Preparation of which it hath no convenient Veſſels or Inſtruments; if it could do ſo, what need of all that *Apparatus* of Veſſels, Preparation of Seed, and, as I alſo ſuppoſe, Diſtinction of Maſculine and Feminine that we ſee in Plants? I demand farther, whether any of the Patrons of ſpontaneous Generation in Plants did ever ſee any Herbs or Trees, except thoſe of the Graſs-Leav'd Tribe, come up without two Seed-Leaves? which if they never did or

could, it is to me a great Argument that they came all of Seed, there being no reaſon elſe why they ſhould at firſt produce two Seed-Leaves different from the ſubſequent; and if all theſe *Species* (which are far the greateſt Number) come from Seed, there is not the leaſt reaſon to think that any of the reſt come up ſpontaneouſly; and this, with what I have written before, may ſuffice concerning this Point.

Whereas I have often written in many Places that ſuch and ſuch Plants are ſpontaneous, or come up ſpontaneouſly, I mean no more by that Expreſſion, but that they were not planted or ſown there induſtriouſly by Man.

Having ſpoken of the Body of Man, and the Uſes of its ſeveral Parts and Members, I ſhall add ſome other Obſervations, giving an Account of the particular Structure, Actions and Uſes of ſome Parts, either common to whole Kinds of Animals, or proper to ſome particular *Species*, different from thoſe of Man, and of the reaſon of ſome Inſtincts and Actions of Brutes.

Firſt of all, the manner of Reſpiration, and the Organs ſerving thereto in various Animals, are accommodated to their Temper of Body, and their Place and Manner of Living; of which I have obſerv'd in more perfect Animals three Differences.

1. The

1. The hotter Animals, which require abundance of Spirits for their various Motions and Exercises, are provided with Lungs, which indefinitely draw in and expel the Air alternately, without Intermission, and have a Heart furnish'd with two Ventricles; because to maintain the Blood in that degree of Heat which is requisite to the Performance of the Actions of all the Muscles, there is abundance of Air necessary. I shall not now take notice of the difference that is between the Lungs of Quadrupeds and Birds, how the one are fix'd and immoveable, the other loose and moveable; the one perforated, transmitting the Air into large Bladders, the other inclos'd with a Membrane.

It is here worth the notice taking, that many Animals of this Kind, both Birds and Quadrupeds, will endure and bear up against the extreamest Rigor of Cold that our Country is expos'd to; *Horse*, *Kine*, and *Sheep*, as I have experienc'd, will lie abroad in the open Air upon the cold Ground during our long Winter-Nights, in the sharpest and severest Frosts that ever happen'd with us, without any Harm or Prejudice at all; whereas one would think, that at least the Extremities of their Members should be bitten, benummed and mortify'd thereby. Considering with myself by what means they were enabled to do this, and to abide and resist the Cold, it occurr'd to my Thoughts, that the Extremities of their

Toes were fenc'd with Hoofs, which in good measure secur'd them; but the main thing was, that the Cold is, as it were, its own Antidote; for the Air being fully charg'd and sated with nitrous, or some other sort of Particles (which are the great Efficients of Cold, and no less also the *Pabulum* of Fire) when inspir'd, doth by means of them cause a great Accension and Heat in the Blood (as we see Fuel burns rashly in such Weather) and so enable it to resist the Impressions of the Cold for so short a time as its more nimble Circulation exposes it thereto, before it comes to another heating. From hence may an Account be given why the Inhabitants of hot Countries may endure longer Fasting and Hunger than those of colder; and those seemingly prodigious, and to us scarce credible Stories, of the Fastings and Abstinence of the *Egyptian* Monks, be render'd probable.

2. Other Animals, which are of a colder Temper, and made to endure a long *Inedia* or fasting, and to lie in their Holes almost torpid all Winter, as all Kinds of *Serpents* and *Lizards*, have indeed Lungs, but do not incessantly breathe, or when they have drawn in the Air, necessarily expire it again, but can retain it at their Pleasure, and live without Respiration whole Days together, as was long since experimented by Sir *Thomas Brown*, M. D. in a Frog ty'd by the Foot under Water for that purpose by him. This Order of Creatures have but one Ventricle in their Hearts, and

the

the whole Blood doth not ſo often circulate thro' the Lungs as it doth thro' the reſt of the Body; this manner of breathing is ſufficient to maintain in them that degree of Heat which is ſuitable to their Nature and manner of living; for to our Touch they are always cold, even in Summer-time, and therefore ſome will then put Snakes into their Boſom to cool them.

3. Fiſhes, which were to live and converſe always in a cold Element, the Water, and therefore were to have a Temper not excelling in Heat, becauſe otherwiſe the conſtant immediate Contract of the Water (unleſs ſome extraordinary Proviſion were made) could not have been ſupported by them, that they might not be neceſſitated continually to be coming up to the top of the Water to draw in the Air, and for many other Reaſons that might be alledg'd, perform their Reſpiration under Water by the Gills, by which they can receive no more Air than is diſpers'd in the Pores of the Water, which is ſufficient to preſerve their Bodies in that Temper of Heat that is ſuitable to their Nature and the Place wherein they live; theſe alſo have but one Ventricle in their Hearts.

But now tho' this be thus, the great and moſt wiſe GOD, as it were purpoſely to demonſtrate that he is not by any Condition or Quality of Place neceſſarily determin'd to one manner of Reſpiration, or one Temper of Body in Fiſhes, he

he hath endu'd the Bodies of ſome of that Tribe of aquatick Creatures with Lungs like viviparous Quadrupeds, and two Ventricles of the Heart, and an Ability of breathing like them, by drawing in and letting out the open Air, ſo contriving their Bodies as to maintain in the midſt of the cold Water a degree of Heat anſwerable to that of the fore-mention'd Quadrupeds.

Another remarkable thing relating to Reſpiration is, the keeping the Hole or Paſſage between the *Arteria Venoſa* and *Vena Cava*, call'd *Foramen ovale*, open in ſome amphibious Quadrupeds, *viz.* the *Phoca*, or *Vitulus Marinus*, call'd in *Engliſh*, *Sea-Calf* and *Seal*; and, as is generally held, the *Beaver* too. We have already given the reaſon of the twofold Communication of the great Blood-Veſſels in the *Fœtus* or Young ſo long as it continues in the Womb; the one between the two Veins entring the Heart, by a Hole or Window; the other between the two Arteries, by an arterial Channel extended from the pulmonary Artery to the *Aorta*, or great Artery; which was, in brief, to divert the Blood from the Lungs. The ſame reaſon for keeping open this *Foramen ovale* there is in theſe amphibious Creatures. For, 1. The Lungs probably being not extended, but empty'd of Air when they abide long under Water, and flaccid, it is not eaſy for the whole Blood every Circulation to make its way thro' them. 2. To maintain that degree of Heat and Motion in the Blood as is ſufficient for them while they are under

der Water, there is not ſo much Air requir'd as is when they are above, the Blood then moving but gently, as doth that of the *Fœtus* in the Womb.

Farther, in reference to Reſpiration, it is obſerv'd by the *Pariſian* Academiſts, that ſome amphibious Quadrupeds, particularly the *Sea-Calf* or *Seal*, hath his *Epiglottis* extraordinarily large in proportion to other Animals, it extending half an Inch in length beyond the *Glottis*, to cover it. I believe the *Beaver* hath the like *Epiglottis*, exactly cloſing the *Larynx* or *Glottis*, and hindring all Influx of Water; becauſe in one diſſected by *Wepferus*, that ſuffocated itſelf in the Water, there was not a Drop of Water found in the Lungs; it is probable (ſay they) that this is done more exactly to cloſe the Entrance of the *Aſpera Arteria*, or Windpipe, when the Animal eats his Prey at the bottom of the Sea, and to hinder the Water from running into his Lungs. An Elephant (as is obſerv'd by Dr. *Moulins*, I think, in the Anatomy of that Creature) hath no *Epiglottis* at all; there being no danger of any thing falling into their Lungs from eating or drinking, ſeeing there is no Communication between the *Oeſophagus* and it; for he thus deſcribes the *Oeſophagus* or Gullet: The Tongue of this Creature (ſaith he) had this peculiar in it, that the Paſſage to the Ventricle was thro' it, for there was a Hole near the Root of it, and exactly in the middle of that Part, which Hole was the beginning of the *Oeſophagus*; there was no Communication between this

this and the Paſſage into the Lungs, contrary to what we may obſerve in Men, in all Quadrupeds and Fowl, that ever I had Opportunity to diſſect; for the *Membrana pituitaria anterior* reach'd to the very Root of the Tongue, below the *Oeſophagus*, and ſo quite ſtopt the Paſſage of the Air into the Mouth. But tho' there be no danger of Meat or Drink falling into the Lungs, yet were they not ſufficiently ſecur'd from ſmall Animals creeping in there; for though, to ſupply in ſome meaſure the want of an *Epiglottis*, by leſſening the *Glottis*, there grew to the outſide of the Cartilages call'd *Arytenoides*, another capable of motion up and down, by the help of ſome Muſcles that were implanted in it, ſtrong on both ſides of the *Aſpera Arteria*, but on the under ſide, oppoſite to that of the *Oeſophagus*, very limber, wanting about two Inches and a half of coming round the aforeſaid Cartilages on the upper ſide, or the next to the *Oeſophagus*; yet did not this Cartilage ſo ſhut up the way againſt them, but that even a *Mouſe* creeping up his *Proboſcis* might get into his Lungs, and ſo ſtifle him; whence we may gueſs at the reaſon why the *Elephant* is afraid of a *Mouſe*; and therefore to avoid this Danger, this Creature (the *Elephant*, which this Author deſcrib'd) was obſerv'd always when he ſlept to keep his Trunk *(Proboſcis)* ſo cloſe to the Ground that nothing but Air could get in between them; this is a ſtrange Sagacity and Providence in this Animal, or elſe an admirable Inſtinct.

Again,

Again, the *Parisian* Academists observe of the *Sea Tortoise*, that the Cleft of the *Glottis* was strait and close; which exact Inclosure I do rather believe is to prevent the Water from entring into the Windpipe when the Tortoises are under Water, than to assist the Effect of the Compression of the Air in the Lungs, as they would have it; for they make the main reason of Respiration and Use of the Lungs in this Creature to be, to take in and retain Air, by the Compression and Dilatation whereof, made by the Muscles, it can raise or sink itself in the Water, as need requires; tho' I do not exclude this. But if this be the main Use of the Lungs and Respiration in this Animal, what is it in Land Animals, which have a like Conformation of Lungs and manner of Respiration as the *Camelion*, *Serpents*, and *Lizards?*

But before I dismiss the Tortoise, I shall add two notable Observations concerning him, borrow'd of the said *French Academists*, which seem to argue something of Reason in him, and more than a bare Instinct. The first is in the *Land Tortoise*; and it is his manner of turning himself, and getting upon his Feet again when he is cast upon his Back, which they describe in these Words: *At the great Aperture of the Shell before, there was at the top a rais'd Border, to grant more liberty to the Neck and Head, for lifting themselves upwards; and this Inflection of the Neck is of great Use to the Tortoises, for it serves them to turn again when*

when they are upon their Backs; and their Industry upon this Account is very admirable. We have obſerv'd in a living Tortoiſe, *that being turn'd upon its Back, and not being able to make uſe of its Paws for the returning of itſelf, becauſe they could but only bend towards the Belly, it could help itſelf only by its Neck and Head, which it turn'd ſometimes on one ſide, ſometimes on the other, by puſhing againſt the Ground, to rock itſelf as in a Cradle, to find out the ſide towards which the Inequality of the Ground might more eaſily permit it to rowl its Shell; for when it had found it, it made all its Endeavours on that ſide.*

The ſecond is in the *Sea Tortoiſe*, as follows. *Ariſtotle* and *Pliny* have remark'd, that when *Tortoiſes* have been a long time upon the Water during a Calm, it happens that their Shell being dry'd in the Sun, they are eaſily taken by the Fiſhermen, by reaſon they cannot plunge into the Water nimbly enough, being become too light; this ſhews what Equality there ought to be in their *Æquilibrium*, ſeeing ſo little a Change as this, which may happen by the ſole drying of the Shell, is capable of making it uſeleſs. This Eaſineſs to be taken at ſuch a time, theſe *Academiſts* do not refer merely to the Lightneſs of this Creature's Body (for he could eaſily let Air enough out of his Lungs to render it heavier than the Water, and ſo enable himſelf to ſink) but to a wonderful Sagacity and Caution of this Animal; for (ſay they) it is probable that the *Tortoiſe*, which

which is always careful to keep himself in this *Æquilibrium*, so as other Animals are to keep themselves on their Legs, in this Case, by the same Instinct, dares not let the Air out of his Lungs, to acquire a Weight which might make him speedily to sink, because he fears that his Shell being wet it should become so heavy, that he being sunk to the bottom of the Water, might never have Power afterwards to re-ascend; if this may be the reason why he exposes himself to the danger of being taken at such a time, rather than he will descend suddenly to the bottom, it is clear that he is endu'd with an admirable Providence and Foresight, and a Power of Argumentation.

That Nature doth really design the Preservation and Security of the more infirm Creatures, by the defensive Armour that it hath given to some of them, together with Skill to use it, is, I think, demonstrable in the common *Hedge-hog*, or *Urchin*, and one Species of *Tatou*, or *Armadillo*. The *Hedge-hog* hath his Back, Sides and Flanks thick set with strong and sharp Prickles, and besides, by the help of a Muscle given him for that purpose, is enabled to contract himself into a globular Figure, and so to withdraw, inclose, and hide his whole Under-part, Head, Belly and Legs (which for the Necessities and Conveniences of Life must be left destitute of this Armour) within his Covert or Thicket of Prickles; so that Dogs, or other rapacious Creatures, cannot lay hold upon him or bite him without

without wounding their own Noſes and Mouths. The Muſcle whereby he is enabled to draw himſelf thus together, and gather up his whole Body like a Ball, the *Pariſian Academiſts* deſcribe to be a diſtinct carnoſe Muſcle, extended from the *Oſſa innominata* to the Ear and Noſe, running along the Back-bone, without being faſten'd thereto. *Olaus Borrichius*, in the *Danick* Tranſactions, makes it to be an almoſt circular Muſcle, embracing the *Panniculus carnoſus*, of a wonderful Fabrick, variouſly extending its *Laciniæ*, or Proceſſes, to the Feet, Tail, and Head of the Creature.

The other Creature which doth thus contract and draw up itſelf into a globular or oval Figure for its Defence, is the ſecond Sort of *Tatou*, or *Armadillo*, largely deſcrib'd by *Marcgrave*, *Lib.* 6. *cap.* 9. by the Name of *Tatu Apara*, which is cover'd on its Back and Sides with a ſtrong ſcaly Cruſt or Shell, of a hard or boney Subſtance, jointed like Armour, or the Scales of the Tail of a Lobſter, by four tranſverſe Commiſſures in the middle of the Body, connected by tough Membranes. When it ſleeps (as it doth for the moſt part in the Day-time, going forth to feed in the Night) or when one goes about to lay hold on it, gathering up its fore and hind Legs as it were to one Point, and drawing its Ears with its Head inward, and bringing its Tail to its Head by reaſon of the fore-mention'd Commiſſures, it

it bends its Back so far till its Head comes to touch its hind Part, and so with Armour gather itself into a round Ball, the lateral Extremities of the Shell touching one another, and inclosing the Body on the Sides, and the fore and hind Parts coming so near together, that there is nothing to be seen but the Armature of the Head and Tail, which, like Doors, shut up the Hole which the Shells of the Body left open; this it performs by the Action of a notable Muscle on each Side, of a great length, having the form of the Letter X, made up of many Fibres, decussating one another long-ways, by the help whereof it can contract its Shell, and hold it contracted with such a mighty Force, that he must be a strong Man indeed that is able to open it.

Had such a Muscle as this, and such an Ability of Contraction, been given to any Creature that was cover'd with soft Hair or Fur, there might have been some Pretence to fancy that this was accidental, and not design'd; but seeing there is not one Instance of this kind in Nature, it must be great Stupidity to believe it, and an Impudence to assert it; neither will the Atheists usual κρησφύγετον, or Refuge, *that there were indeed at first such Creatures produc'd, but being obnoxious to those that were strong and rapacious, they were by degrees destroy'd, and the Race lost*, here help them out; because such a Muscle, and Faculty of using it to that Purpose, might as likely have fallen to the Lot or Chance of a strong and

generous Creature, which others dar'd not approach to hurt, who might for his own Diſport have thus contracted himſelf into a Ball, of which Kind we find none.

I have before mention'd the Uſe aſſign'd by the honourable Mr. *Boyle*, of famous Memory, lately deceas'd, to the *Periophthalmium*, or nectating Membrane in Brutes, wherein I could not fully acquieſce as to ſome Quadrupeds, which were in no danger of having their Eyes harm'd by Buſhes and Prickles, or Twigs of Trees; ſince the writing whereof I have met with a different Account of the Uſe of that Membrane, in the *Anatomical Deſcription of ſeveral Creatures diſſected by the Royal Academy of Sciences at* Paris, Engliſh'd by Mr. *Alexander Pitfield*, p. 249. in the Deſcription of the *Caſſowar*. Our Opinion (ſay thoſe Academiſts) is, that the Membrane ſerves to clean the *Cornea*, and to hinder, that by drying, it grow no leſs tranſparent. Man and the Ape, which are the ſole Animals wherein we have not found this Eye-lid, have not wanted this Proviſion for the cleanſing of their Eyes, becauſe that they have Hands, with which they may, by rubbing their Eye-lids, expreſs the Humidity which they contain, and which they let out through the *Ductus Lachrymalis*; which is known by Experience, when the Sight is darken'd, or when the Eyes ſuffer any Pain or itching; for theſe Accidents do ceaſe when the Eyes are rubb'd.

But

But the Diſſection has diſtinctly diſcover'd to us the Organs which do particularly ſerve for this Uſe, and which are otherwiſe in Birds than in Man, where the *Ductus* paſſes not beyond the *Glandula Lachrymalis*; for in Birds it goes beyond, and penetrating above half way on the internal Eye-lid, it is open'd underneath upon the Eye; which is evidently done to ſpread a Liquor over the whole *Cornea*, when this Eye-lid paſſes and repaſſes, as we obſerv'd it to do every Moment.

The Artifice and Contrivance of Nature for the extending and withdrawing of this Curtain of the *Periophthalmium* in Birds is admirable; but it is difficult ſo to expreſs it in Words as to render it intelligible to the Reader; for a multitude of Words doth rather obſcure than illuſtrate, they being a Burden to the Memory, and the firſt apt to be forgotten before we come to the laſt; ſo that he that uſes many Words for the explaining any Subject, doth, like the *Cuttle-Fiſh*, hide himſelf for the moſt part in his own Ink; and in the Deſcription of the Figure and manner of the Extenſion and Contraction of this Membrane, the *Pariſian Academiſts* are conſtrain'd to uſe ſo many Words, that I am afraid few Readers Patience and Attention will laſt ſo long as to comprehend and carry it away; yet becauſe it is ſo evident and irrefragable a Proof of Wiſdom and Deſign, I could not omit it; their Words are theſe: The Particularities of the admirable Structure of this Eye-lid are ſuch things as do diſtinctly diſcover

the Wisdom of Nature among a thousand others, of which we perceive not the Contrivance, because we understand them only by the Effects, of which we know not the Causes; but we here treat of a Machine, all the Parts whereof are visible, and which need only to be look'd upon to discover the reason of its Motion and Action.

This internal Eye-lid in Birds is a membranous Part, which is extended over the *Cornea* when it is drawn upon it like a Curtain by a little Cord or Tendon, and which is drawn back again into the great Corner of the Eye, to uncover the *Cornea*, by the means of the very strong Ligaments that it has, and which in drawing it back towards its Origin do fold it up; it made a Triangle when extended, and it had the Figure of a Crescent when folded up; its *Basis* (which is its Origin) was toward the great Corner of the Eye, at the edge of the great Circle, which the *Sclerotica* forms when it is flatted before, making an Angle with its anterior Part, that is, the *Cornea*, which is rais'd like a Hill upon it; the *Basis*, which is the Part immoveable, and fasten'd to the edge of the *Sclerotica*, did take up more than a third Part of the Circumference of the great Circle of the *Sclerotica*; the side of the Triangle, which is toward the little Corner of the Eye, and is moveable, was reinforc'd with a Border, which supplies the place of the *Tarsus*, and which is black in most Quadrupeds; this side of the Eye-lid is that which is drawn back into the Corner of the

Eye, by the Action of the Fibres of the whole Eye-lid, which parting from its Origin, proceed to join themſelves to its *Tarſus*.

To extend this Eye-lid over the *Cornea*, there were two Muſcles that were ſeen, when ſix were taken away, which ſerv'd to the Motion of the whole Eye; we found that the greateſt of theſe two Muſcles has its Origin at the very edge of the great Circle of the *Sclerotica*, towards the great Corner, from whence the Eye-lid takes its Original; it is very fleſhy in its beginning, which is a large *Baſis*, from whence coming inſenſibly to contract itſelf by paſſing under the Globe of the Eye, like as the Eye-lid paſſes over it, it approaches the Optick Nerve, where it produces a Tendon round and ſlender, ſo that it paſſes thro' the Tendon of the other Muſcle, which ſerves for a Pulley, and which hinders it from preſſing the Optick Nerve, upon which it is bent, and makes an Angle, to paſs thro' it to the upper Part of the Eye, and coming out from underneath the Eye to inſert itſelf at the Corner of the Membrane which makes the internal Eye-lid; this ſecond Muſcle hath its Original at the ſame Circle of the *Sclerotica*, but oppoſite to the firſt towards the little Corner of the Eye, and paſſing under the Eye like the other, goes to meet it, and embraces its Tendon, as has been declar'd.

The Action of theſe two Muſcles is, in reſpect to the firſt, to draw, by the means of its Cord or

Tendon, the Corner of the internal Eye-lid, and to extend it over the *Cornea*; as to the ſecond Muſcle, its Action is, by making its Tendon to approach towards its Origin, to hinder the Cord of the firſt Muſcle, which it embraces, from hurting the Optick Nerve; but its principal Uſe is to aſſiſt the Action of the firſt Muſcle; and it is herein that the Mechaniſm is marvellous in this Structure, which makes that theſe two Muſcles join'd together do draw much farther than if it had but one; for the Inflection of the Cord of the firſt Muſcle, which cauſes it to make an Angle on the Optick Nerve, is made only for this End; and a ſingle Muſcle with a ſtrait Tendon had been ſufficient, if it had Power to draw far enough; but the Tractation which muſt make the Eye-lid extend over the whole *Cornea* being neceſſarily great, it could not be done but by a very long Muſcle, and ſuch a Muſcle not being able to be lodg'd in the Eye all its length, there was no better way to ſupply the Action of a long Muſcle than by that of two indifferent ones, and by bending one of them to give it the greater Length in a little Space. Thus far the *Academiſts*, who themſelves reflecting on the Length and Obſcurity of this Deſcription, tell us, that the Inſpection of the Figure will ſerve greatly to the underſtanding of it, which the Novelty of the thing renders obſcure in itſelf, and ſo I fear it will be to moſt Readers; howbeit, in ſuch a Work as this I ought not by any means, as I ſaid before, to leave out ſuch a notable Inſtance, wherein

Contrivance

Contrivance and Design do so clearly and undeniably appear.

The same *Academists*, as I remember, tell us, that they have found by Experience that the aqueous Humour of the Eye will not freeze; which is very admirable, seeing it hath the Perspicuity and Fluidity of common Water, and hath not been taken notice of, so far as I have heard, to have any eminent Quality discoverable either by Taste or Smell; so that it must be of some singular and æthereal nature, and deserves to be examin'd and annaliz'd by the curious Naturalists of our Times.

The Providence of Nature is wonderful in a *Camel* or *Dromedary*, both in the Structure of his Body and in the Provision that is made for the Sustenance of it; concerning the first I shall instance only in the Make of his Foot, the Sole whereof, as the *Parisian Academists* do observe, is flat and broad, being very fleshy, and cover'd only with a thick, soft, and somewhat callous Skin, but very fit and proper to travel in sandy Places, such as are the Desarts of *Africk* and *Asia*; we thought (say they) that this Skin was like a living Sole, which wore not with the Swiftness and the Continuance of the March, for which this Animal is almost indefatigable; and it may be this Softness of the Foot, which yields and fits itself to the Ruggedness and Unevenness of the Roads, does render the Feet less capable of being worn than if they were more solid.

As to the ſecond, the Proviſion that is made for their Suſtenance in their continu'd Travels over ſandy Deſarts, the ſame Academiſts obſerve, that at the top of the ſecond Ventricle (for they are ruminant Creatures, and have ſowre Stomachs) there were ſeveral ſquare Holes, which were the Orifices of about twenty Cavities, made like Sacks, plac'd between the two Membranes which do compoſe the Subſtance of this Ventricle; the View of theſe Sacks made us to think that they might well be the Reſervatories, where *Pliny* ſays that Camels do a long time keep the Water, which they drink in great abundance when they meet with it, to ſupply the Wants which they may have thereof in the dry Deſarts wherein they are us'd to travel, and where it is ſaid that thoſe that do guide them are ſometimes forc'd, by Extremity of Thirſt, to open their Bellies, in which they do find Water.

That ſuch an Animal as this, ſo patient of long Thirſt, ſhould be bred in ſuch droughty and parch'd Countries, where it is of ſuch eminent Uſe for travelling over thoſe dry and ſandy Deſarts, where no Water is to be had ſometimes in two or three Days Journey, no candid and conſiderate Perſon but muſt needs acknowledge to be an Effect of Providence and Deſign.

Such Animals as feed naturally upon Fleſh, both Quadrupeds and Birds, becauſe ſuch kind of Food

Food is high and rank, do qualify it, the one by ſwallowing the Hair or Fur of the Beaſts they prey upon, the other by devouring ſome part of the Feathers of the Birds they gorge themſelves with, not electively, but becauſe they cannot or will not take the Pains fully to plume them; and therefore the *Pariſian Academiſts* do rationally refer the Death of one of the Lions whom they diſſected, to the feeding of him with too ſucculent and delicate Meat; for (ſay they) we know that ſome time before his Death he was ſeveral Months without going out of his Den, and that it was hard to make him eat; that for this reaſon ſome Remedies were preſcrib'd to him, and among others the eating only the Fleſh of young Animals, and thoſe alive; and that thoſe which look'd to the Beaſts of the Park of *Vicennes*, to make this Food more delicate, did uſe a Method very extraordinary; which was, they flead Lambs alive, and thus made him eat ſeveral; which at the firſt reviv'd him, creating in him an Appetite, and making him briſk; but it is probable that this Food engender'd too much Blood, and which was too ſubtile for an Animal to whom Nature had not given the Induſtry of fleaing thoſe which he eat; it being credible that the Hair, Wool, Feathers, and Scales, which all Animals of Prey do ſwallow, are a ſeaſonable and neceſſary Corrective, to prevent their Greedineſs from filling themſelves with too ſucculent a Food.

Tho' I have declar'd in the beginning of this Work that the Means whereby cartilaginous

Fiſhes

Fiſhes raiſe and ſink themſelves in the Water, and reſt and abide in what Depth they pleaſe, is not yet certainly known, yet I ſhall propound a Conjecture concerning it, which was firſt ſuggeſted to me by Mr. *Peter Dent*, late Phyſician in *Cambridge*, viz. that it is by the help of Water which they take in and let out by two Holes in the lower Part of their *Abdomen* or Belly, near the Vent, or not far off it; the Fleſh of this Sort of Fiſh being lax and ſpongy, and nothing ſo firm, ſolid and weighty as that of the boney Fiſhes, and there being a good Quantity of Air contain'd in the Cavity of their *Abdomen*, they cannot ſink in the Water without letting in ſome of it by theſe Holes (the Orifices whereof are open'd and ſhut at pleaſure by the help of Muſcles provided for that purpoſe) into the hollow of their Bellies, whereby they preponderate the Water, and deſcend; and when they would aſcend, by a Compreſſion wrought by the Muſcles of the *Abdomen*, they force out the Water again, or at leaſt ſo much of it as may ſuffice to give that degree of Levity they need or deſire; if it be found by Experience that the Bodies of theſe Fiſhes without this Ballaſt would naturally float in the Water, and that they do really admit Water into their Bellies, then this Conjecture may have ſome Probability or Truth in it, otherwiſe not.

Upon the Contemplation and Conſideration of thoſe various Ways and Contrivances which Nature (I mean the divine Wiſdom) hath made uſe of

of for preparing the Chyle, ſeparating the nutricious Juice from the groſſer Parts of the Aliment, and the ſeveral Humours and Spirits from the Blood, I cannot but admire her great Wiſdom, Art, and Curioſity; for ſhe hath not only employ'd all thoſe Methods and Devices which Chymiſts have either learn'd by Imitation of her, or invented of themſelves, for annalizing of Bodies, ſeparating their Parts, the pure from the impure, and extracting their Spirits, *&c.* as *Maceration* in the firſt Stomach or Paunch of ruminating Creatures, and in the Craws of Birds; *Comminution*, by grinding in the Mouths of viviparous Quadrupeds, and in the Gizzards of Poultry; *Fermentation* in the Stomachs of moſt terreſtrial, and all aquatick Animals; *Expreſſion* and ſqueezing in the *Omaſus* of ruminant Quadrupeds, and in the Inteſtines of all Creatures, by the motion of the Midriff and other Muſcles of the Belly, forcing the Chyle out of the *Fæces* or Excrements into the lacteal Veins; *Straining* or *Percolation* by all the *Viſcera* of the Body, which are but as ſo many Colanders to ſeparate ſeveral Juices from the Blood; and laſtly, *Digeſtion* and *Circulation* in the ſpermatick Parts and Veſſels, and perhaps alſo in the Brain; I ſay, it hath not only made uſe of theſe Operations, but it hath quite out-done the Chymiſts, effecting that by a gentle Heat which they cannot perform without great Streſs of Fire; as for inſtance, in the Stomach of a Dog, preparing a Liquor that diſſolves Bones; and in the Bodies of ſome Inſects, a Liquor which ſeems to

be

be as highly acid and corrosive as Oil of Vitriol or Spirit of Nitre, *viz.* that which is instill'd into the Blood when they sting; it is an Experiment I have met with in some Books, and made myself, that if you put Blue-bottles, or other blue Flowers into an Ant-hill, they will presently be stain'd with red; the reason (which these Authors render not) is, because the Ants thrust in their Stings into the Flowers, and instil into or drop upon them a small Mite of their stinging Liquor, which hath the same Effect that Oil of Vitriol would have in changing their Colour, which is a sign that both Liquors are of the same nature.

Casper Bartholine hath observ'd, that where the Gullet perforates the Midriff, the carneous Fibres of that muscular Part are inflected and arcuate, as it were a *Sphincter* embracing and closing it fast, by a great Providence of Nature, lest in the perpetual Motion of the Diaphragm the upper Orifice of the Stomach should gape, and cast out the Victuals as fast as it receiv'd it; and *Peyerus* thinks he hath observ'd, that in ruminating Creatures the Connection of the Gullet with the Diaphragm is far straiter and stronger than in Man and other Animals, to the end that there should not be more than one Morsel forc'd out at once; for that external Sphincter inhibits a too great Dilatation of the Gullet, and doth as it were measure out the Morsels, and fit them to the Capacity of the *Oesophagus*.

I shall

I ſhall conclude with a notable Relation of *Galen*'s, *Lib.* 6. *de locis effectis*, *cap.* 6. concerning a Kid taken by him alive out of the Dam's Belly, and nouriſh'd and brought up.

Ἡ διαπλάσασά τε καὶ τελειώσασα φύσις εἰργάσατο χωρὶς διδασκαλίας ἐπὶ οἰκείαν ἐνέργειαν ἔρχεσθαι· καὶ βάσανόν γε τούτου μεγίστην ἐποιησάμην ποτὲ θρέψας ἔριφον, ἄνευ τοῦ θεάσασθαί ποτε τὴν κυήσασαν· αἶγας γὰρ ἐγκύμονας ἀνατεμὼν ἕνεκα τῶν ἐζητημένων θεωρημάτων τοῖς ἀνατομικοῖς ἀνδράσι περὶ τῆς κατὰ τὸ κυούμενον οἰκονομίας, εὑρὼν ποτὲ γενναῖον τὸ ἔμβρυον ἀπέλυσα μὲν τῆς μήτρας ὥσπερ εἰώθαμεν· ἁρπάσας δὲ πρὶν θεάσασθαι τὴν κυήσασαν εἰς οἶκον μὴν τινα κομίσας κατέθηκα, πολλὰ μὲν ἔχοντα λεκάνια· τὸ μὲν οἴνου, τὸ δὲ ἐλαίου, τὸ δὲ μέλιτος, τὸ δὲ γαλακτος, ἢ ἄλλου τινὸς ὑγροῦ πλῆρες, οὐκ ὀλίγα δὲ ἄλλα τῶν Δημητρίων καρπῶν, ὥσπερ δὲ καὶ τῶν ἀκροδρύων ἐθεασαμεθα δὲ τὸ ἔμβρυον ἐκεῖνο, πρῶτον μὲν βαδίζον τοῖς ποσὶν, ὥσπερ ἀκηκοὼς ἕνεκα βαδίσεως ἔχειν τὰ σκέλη· δεύτερον δὲ ἀποσειόμενον τὴν ἐκ τῆς μήτρας ὑγρότητα, καὶ τρίτον ἐπὶ τούτῳ κυσάμενον ἑνὶ τῶν ποδῶν τὴν πλευρὰν, εἶ τ' ὀσμώμενον εἴδομεν αὐτὸ τῶν κειμένων κατὰ τὸν οἶκον ἑκάστου, ὡς δὲ πάντων ὠσμᾶτο τοῦ γάλακτος ἀπερόφησεν ἐν ᾧ καὶ ἀνεκράγαμεν ἅπαντες, ἐναργῶς ὁρῶντες ὅπερ Ἱπποκράτες ἔφη φύσεις ζώων ἀδίδακτοι. Καὶ τοίνυν καὶ ἀνεθρεψάμην ἐκεῖνο τὸ ἔριφιον εἰδομέν τε προσφερόμενον ὕστερον οὐ τὸ γάλαμόνον, ἀλλὰ καὶ ἀλλὰ τινὰ τῶν κειμένων· ὄντος δὲ τοῦ καιροῦ καθ' ὃν ἐξηρέθη τῆς μητρὸς ὁ ἔριφος, ἐγγὺς τῆς εἰαρινῆς ἰσημερίας, μετὰ δύο ποῦ μῆνας εἰσεκομισάμην αὐτῷ μαλακοῦς ἀκρέμονας θάμνων τε καὶ φυτῶν, ὧν πάλιν καὶ αὐτῶν ὀσμησάμενον ἁπάντων, ἐνίον μὲν εὐθέως ἀπέστη

τινῶν

πνῶν δ' ἠζίωσε γεύσασθαι, καὶ γαστὰ ἐνίων ἐπὶ τὴν ἐδωδὴν ἐτράπετο τῶν καὶ τῶν μεγάλαις αἰζὶ συνήθων ἐδεσμάτων. Ἀλλὰ τοῦτο μὲν ἴσως μικρόν· ἐκεῖνο δὲ μέγα. Τὰ κὰρ φύλλα καὶ τοὺς μαλακοὺς ἀκρέμονας ἀποφαγὼν κατέπιεν· εἶτ' ὀλίγον ὕστερον ἐπὶ τὸ μηρυκάζειν ἧκεν, ὃ τάλιν θεασάμενοι πάντες ἀνεβόησαν ἀκπλαγνέτες ἐπὶ τῆς τῶν ζώων δυνάμεσι· μέγα μὲν γὰρ ἦν καὶ τὸ πεινῆσαν διά τε τοῦ στόματος καὶ τῶν ὀδόντων προσφέρεσθαι τὴν ἐδωδήν· ἀλλ' ὅτε τὸ καταποθὲν εἰς τὴν γαστέρα, πρῶτον μὲν ἀναφέρειν εἰς τὸ στόμα προσήκεν, ἔπειτα λεαίνειν ἐν αὐτῷ μασσώμενον ἐν χρόνῳ πύλλῳ, καὶ μετὰ ταῦτα καταπίνειν μηκέτι εἰς τὴν ἀτὴν κοιλίαν, ἀλλ' εἰς ἑτέραν ἱκανῶς ἡμῖν ἐφαίνετο θαυμάσιον εἶναι. Παρορῶσι δὲ πολλοὶ τὰ τοιαῦτα τῆς φύσεως ἔργα, μόνα τὰ ξένα θεάματα θαυμάζοντες. That is to ſay,

Nature forming, faſhioning, and perfecting the Parts of the Body, hath ſo brought it to paſs, that they ſhould of themſelves, without any teaching, ſet about and perform their proper Actions; and of this I once made a great Experiment, bringing up a Kid without ever ſeeing its Dam; for diſſecting ſome Goats great with Young, to reſolve ſome Queſtions made by Anatomiſts concerning the Oeconomy of Nature in the Formation of the Fœtus *in the Womb, and finding a briſk* Embryon [*young one*] *I loos'd it from the* Matrix *after our uſual manner, and ſnatching it away before it ſaw its Dam, I brought it into a certain Room, having many Veſſels full, ſome of Wine, ſome of Oil, ſome of Honey, ſome of Milk, or ſome other Liquor; and others, not a few, fill'd with all Sorts of Grain, as alſo with ſeveral Fruits, and there laid it. This* Embryon *we ſaw*

firſt

first of all getting up on its Feet and walking, as if it had heard that its Legs were given it for that purpose; next shaking off the Slime it was besmear'd with from the Womb; and moreover, thirdly, scratching its Side with one of its Feet; then we saw it smelling to every one of those things that were set in the Room; and when it had smelt to them all, it supp'd up the Milk; whereupon we all for Admiration cry'd out, seeing clearly the Truth of what Hippocrates *saith, that the Natures and Actions of Animals are not taught (but by Instinct.) Hereupon I nourish'd and rear'd this Kid, and observ'd it afterwards not only to eat Milk, but some other things that stood by it. And the Time when this Kid was taken out of the Womb being about the Vernal Equinox, after some two Months, were brought into it the tender Sprouts of Shrubs and Plants, and it again smelling of all of them, instantly refus'd some, but was pleas'd to taste others; and after it had tasted, began to eat of such as are the usual Food of Goats. Perchance this may seem a small thing, but what I shall now relate is great; for eating the Leaves and tender Sprouts, it swallow'd them down, and then a while after it began to chew the Cud, which all that saw cry'd out again with Admiration, being astonish'd at the Instincts and natural Faculties of Animals; for it was a great thing that when the Creature was hungry it should take in the Food by the Mouth, and chew it with its Teeth; but that it should bring up again into the Mouth that which it had swallow'd down in-*

to its first Stomach, and chewing it there a long time, it should grind and smooth it, afterwards swallow it again, not into the same Stomach, but into another, seem'd to us wonderful indeed. But many neglect such Works of Nature, admiring only strange and unusual Sights. So far *Galen.*

This pleasant and admirable Story, should one consider all the Particulars of it, and endeavour to give an Account of them, as also all the Inferences that might be drawn from it, one might fill a whole Volume with Comments upon it. All that I shall at present say is this, That in all this Oeconomy, and these Actions, Council and Design doth so clearly appear, that he must needs be very stupid that doth not discern it, or impudent that can deny it. I might add, that there seems to be something more than can be perform'd by mere Mechanism in the Election this Creature made of its Food; for before it would eat of any, it smell'd to all the Liquors before it, and when it had done so, betook itself to the Milk, and devour'd that; he doth not say that the Milk was the last Liquor it smell'd to, or that when it had once smell'd to that, it presently drank it up. The like also he saith of all

all the Sprouts and Branches of Plants that were laid before it. By the by we may take notice of one thing very remarkable, that this Kid of its own accord drank Milk after the manner it had done in the Womb; whereas had it once drawn by the Nipple, it would hardly have ſupp'd the Milk; and therefore in weaning young Creatures the beſt way is never to let them ſuck the Paps at all, for then they will drink up Milk without any difficulty; whereas if they have ſuck'd, ſome will very hardly, others by no means be brought to drink: But how do the Young with ſuch Facility come to take the Nipple, and to ſuck at it, which they had never before us'd to do? Here we muſt have recourſe to natural Inſtinct, and the Direction of ſome ſuperior Cauſe.

Notice hath been already taken in an Obſervation communicated by my learned Friend Dr. *Tancred Robinſon*, of the Providence of Nature in ſo forming the Membranes of the Body as to be capable of a prodigious Dilatation and Extenſion, which is of great Uſe in ſome Diſeaſes; for Example, the Dropſy, to continue Life for ſome time till Remedy may be had; and if not, to give time to prepare for Death: But the Wiſdom and Deſign of this Texture doth in no Inſtance more clearly appear, than in the neceſſity of it for the Womb in the time of Geſtation; for were not the Womb in Women, which during Virginity is not bigger than a ſmall Purſe, almoſt infinitely dilatable, and alſo the *Peritoneum*, not to mention

the Skin and the *Cuticula*, how were it possible it should contain the Child, nay, sometimes Twins, with all their Appurtenances, the Secundines, the *Placenta*, the Liquor or Waters, and what else is necessary for the Defence, Nutrition, Respiration, and soft and convenient lodging of them, till they come to their due Perfection and Maturity for Exclusion? How could the Child have room to grow there to his Bigness, and stir and turn himself, as is requisite? Add hereto another Observation of *Blasius*'s, particularly relating to this Subject; he hath observ'd that the Vessels of the interior glandulous Substance of the Womb are strangely contorted and reflected with Turnings and Meanders, that they might not be too much strain'd, but their Folds being extended and abolish'd, they might accommodate themselves without danger of Rupture to the necessary Extension of the uterine Substance at that time.

Another remarkable Proof of Counsel and Design may be fetch'd from the Formation of the Veins and Arteries near the Heart, which I meet with in Dr. *Lower*'s Treatise, *de Corde*. Just before the entrance of the Right Auricle of the Heart (saith he) to wit, where the ascending Trunk of the *Vena Cava* meeting with the descending, is ready to empty itself into the said Right Auricle, there occurs in it a very remarkable Knob or Bunch [*Tuberculum*] rais'd up from the subjacent Fat, by the Interposition whereof the Blood falling down by the descending Vein is diverted in the

the Auricle, which otherwiſe encountring and bearing upon that of the aſcendent Trunk, would very much hinder and retard the motion of it upward towards the Heart; and becauſe in an erect Site and Figure of the Body there is a greater and more imminent danger of ſuch an Accident, therefore the *Vena Cava* in Mankind hath this Tubercle far greater and of more extent than it is in Brutes; ſo that if you thruſt your Finger into either Trunk, you can hardly find Paſſage or Admittance into the other.

But in Quadrupeds, as in *Sheep*, *Dogs*, *Horſe*, *Kine*, in which the Courſe of the Blood from either Extreme of the Body is more equal, and as it were in a plainer Level; and becauſe the Heart by reaſon of its Bulk and Weight hanging downwards, both Trunks of the *Vena Cava* have ſome little Declivity towards it, there is no need of ſo great a Bar and Diverſion in them, yet are they not altogether devoid of it.

Moreover, leſt the Blood here in its Conflux ſhould make a kind of Flood and Whirlpool, whilſt the Auricle being contracted doth not give it free Ingreſs, therefore in this place the *Vena Cava* in great Animals, as well Man as Quadrupeds, is round about muſculous, as well that it may be reſtrain'd and kept within its due Limits of Extenſion, as that it may more vigorouſly and ſtrongly urge and impel the Blood into the Cavity of the Auricle.

Beſides, there is no leſs Providence and Caution us'd that the Blood, when it is forcibly caſt out of the Left Ventricle of the Heart, be not unequally diſtributed to the ſuperior and inferior Parts; for whereas this Gate or Orifice of the Heart opens right upwards, if that Channel which receives the firſt Impulſe of the Blood did lead in a ſtrait Line up to the Region of the Head, it could not be but that it muſt be pour'd too ſwiftly upon the Brain, and ſo the inferior Parts of the Body muſt needs be defrauded of their vital Liquor and Aliment; which Inconvenience, that the divine Architect of the Body might wholly obviate and avoid in Animals, whoſe Hearts are more ſtrongly mov'd, he ſo artificially contriv'd the Trunk of the *Aorta*, which is next the Heart, that the Blood runs not directly into the axillary and carotid Arteries, but doth as it were fetch a Compaſs; for in the middle Space between the Ventricle and thoſe Arteries it is very much inflected or bent; whence it comes to paſs that that crooked Angle ſuſtains the Force and firſt Stroke of the ejected Blood, and directs the greateſt Torrent of it towards the deſcending Trunk of the *Aorta*, which otherwiſe would ruſh too forcibly into the ſuperior Branches thereof, diſtending them immoderately, and ſoon oppreſs and burden the Head. *So far Dr.* Lowther.

To elude or evade the Force of all theſe Inſtances, and innumerable others which might be produc'd, to demonſtrate that the Bodies of Men and

all other Animals were the Effects of the Wisdom and Power of an intelligent and almighty Agent, and the several Parts and Members of them design'd to the Uses to which now they serve, the *Atheist* hath one Subterfuge, in which he most confides, *viz.* that all these Uses of Parts are no more than what is necessary to the very Existence of the Things to whom they belong, and what Things made Uses, and not Uses Things.

—— *Nil ideo natum est in corpore ut uti*
Possemus, sed quod natum est id procreat usum.
Saith *Lucretius*, Lib. 4.

And having instanc'd in several Members, he concludes,

—— *Omnia denique membra*
Ante fuere, ut opinor, eorum quàm fuit usus.

I shall give you their Sense, together with the Confutation of it, in Dr. *Bentley*'s Words, borrow'd out of his fifth Lecture, *&c.*

These things (say * they) are mistaken for Tokens of Skill and Contrivance, whereas they are but necessary Consequences of the present Existence of those Creatures to which they belong; for he that supposeth any Animals to subsist, doth by that very Supposition allow them every Member and Faculty that are necessary to Subsistence; and therefore unless

* *The Atheists.*

we can prove *à priori*, and independent on this Usefulness, now that Things are once suppos'd to have existed and propagated, that among almost infinite Trials and Essays at the beginning of Things, among Millions of monstrous Shapes and imperfect Formations, a few such Animals as now exist could not *possibly* be produc'd, these after-Considerations are of very little moment; because if such Animals could in that way *possibly* be form'd, as might live and move, and propagate their Beings, all this admir'd and applauded Usefulness of their several Fabricks is but a necessary Condition and Consequence of their Existence and Propagation.

This is the last Pretence and Sophistry of the *Atheists* against the Proposition in my Text [*Acts* xvii. 27.] that we receiv'd our Life and Being from a divine Wisdom and Power; and as they cannot justly accuse me of concealing or baulking their grand Objection, so I believe these following Considerations will give them no reason to boast that it cannot receive a just and satisfactory Answer.

(1.) *First*, therefore, we affirm that we can prove, and have done it already by Arguments *à priori* (which is the Challenge of the *Atheists*) that these Animals that now exist could not possibly have been form'd at first by Millions of Trials; for seeing they allow by their very *Hypothesis* (and without standing to that Courtesy we have prov'd

prov'd it before) that there can be no casual or spontaneous motion of the Particles of Matter, it will follow, that every single Monster, among so many suppos'd Myriads, must have been mechanically and necessarily form'd, according to the known Laws of Motion, and the Temperament and Quality of the Matter it was made of, which is sufficient that no such Monsters were or could have been form'd; for to denominate them even Monsters they must have had some rude kind of organical Bodies, some *Stamina* of Life, tho' never so clumsy, some *System* of Parts, compounded of Solids and Liquids, that executed (tho' but bunglingly) their peculiar Motions and Functions. But we have lately shewn it impossible for Nature unassisted to constitute such Bodies, whose Structure is against the Law of specifick Gravity; so that she could not make the least Endeavour towards the producing of a Monster, or of any thing that hath more vital and organical Parts than we find in a Rock of Marble or a Fountain of Water. And again, tho' we should not contend with them about their Monsters and Abortions, yet seeing that they suppose even the perfect Animals that are still in being to have been form'd mechanically among the rest, and only add some Millions of Monsters to the Reckoning, they are liable to all the Difficulties in the former Explication, and are expresly refuted thro' the whole preceding *Sermon*, where it is abundantly shewn that a spontaneous Production is against the Catholick Laws of Motion, and a-

gainſt Matter of Fact, a thing without Example, not only in Man and the nobler Animals, but in the ſmalleſt of Inſects and the vileſt of Weeds; tho' the Fertility of the Earth cannot be ſaid to have been impair'd ſince the beginning of the World.

(2.) *Secondly*, We may obſerve that this Evaſion of the *Atheiſt* is fitted only to elude ſuch Arguments of divine Wiſdom as are taken from Things neceſſary to the Conſervation of the Animal, as the Faculties of Sight, and Motion, and Nutrition, and the like, becauſe ſuch Uſefulneſs is indeed included in a general Suppoſition of the Exiſtence of that Animal; but it miſerably fails him againſt other Reaſons, from ſuch Members and Powers of the Body as are not neceſſary abſolutely to living and propagating, but only much conduce to our better Subſiſtence and happier Condition. So the moſt obvious Contemplation of the Frame of our Bodies, as that we all have double *Senſories*, two *Eyes*, two *Ears*, two *Noſtrils*, is an effectual Confutation of this atheiſtical Sophiſm; for a double Organ of theſe Senſes is not at all comprehended in the Notion of bare Exiſtence, one of them being ſufficient to have preſerv'd Life and continu'd the Species, as common Experience witneſſeth. Nay, even the very Nails of our Fingers are an infallible Token of Deſign and Contrivance, for they are uſeful and convenient, to give Strength and Firmneſs to thoſe Parts in the various Functions they are put to,

and

and to defend the numerous Nerves and Tendons that are under them, which have a moſt exquiſite Senſe of Pain, and without that native Armour would continually be expos'd to it; it is manifeſt therefore that there was a Contrivance and Foreſight of the Uſefulneſs of Nails antecedent to their Formation; for the old ſtale Pretence of the *Atheiſts*, that Things were firſt made fortuitouſly, and afterwards their Uſefulneſs was obſerv'd or diſcover'd, can have no place here, unleſs Nails were either abſolutely requiſite to the Exiſtence of Mankind, or were found only in ſome Individuals or ſome Nations of Men, and ſo might be aſcrib'd to Neceſſity upon one Account, or to Fortune upon another. But from the *Atheiſts* Suppoſition, that among the infinite Diverſity of the firſt terreſtrial Productions, there were Animals of all imaginable Shapes and Structures of Body, all of which ſurviv'd and multiply'd, that by reaſon of their Make and Fabrick could poſſibly do ſo, it neceſſarily follows that we ſhould now have ſome Nations without Nails upon their Fingers, others with one Eye only, as the Poets deſcribe the *Cyclopes* in *Sicily*, and the *Arimaſpi* in *Scythia*; others with one Ear, or with one Noſtril, or indeed without any Organ of ſmelling, becauſe that Senſe is not neceſſary to Man's Subſiſtence; others deſtitute of the Uſe of Language, ſeeing that Mutes alſo may live. One People would have the Feet of Goats, as the feign'd *Satyrs* and *Paniſci*; another would reſemble the Head of *Jupiter Ammon*, or the horned Statues

of

of *Bacchus*; the *Sciopedes* and *Enotocetæ*, and other monſtrous Nations, would be no longer Fables, but real Inſtances in Nature; and in a word, all the ridiculous and extravagant Shapes that can be imagin'd, all the Fancies and Whimſies of Poets and Painters, and *Ægyptian* Idolaters, if ſo be they are conſiſtent with Life and Propagation, would be now actually in Being if our *Atheiſts* Notion were true; which therefore may deſervedly paſs for a mere Dream and an Error, till they pleaſe to make new Diſcoveries in the *Terra incognita*, and bring along with them ſome Savages of all theſe fabulous and monſtrous Configurations. Thus far Dr. *Bentley:* who adds four Conſiderations more to confute this Fancy, *ex abundanti*, granting the *Atheiſt* all the abſurd Suppoſitions he can make; for which, tho' they be very well worth the reading, yet being too long to tranſcribe, I refer the Reader to the *Sermon* itſelf.

I ſhall now farther prove by a notable Inſtance that Uſes made Things, that is to ſay, that ſome Things were made deſignedly and on purpoſe for ſuch an Uſe as they ſerve to; and that is, the Tendrels or Claſpers of Plants, becauſe they are given only to ſuch Species as have weak and infirm Stalks, and cannot raiſe up to ſupport themſelves by their own Strength; we ſee not ſo much as one Tree, or Shrub, or Herb, that hath a firm and ſtrong Stem, and that is able to mount up and ſtand alone without Aſſiſtance, furniſh'd with them; whereas had they been without Deſign

ſcatter'd

ſcatter'd (as I may ſay) indifferently and careleſly among Plants, it could not poſſibly have happen'd but among ſo many thouſand *Species* they muſt have fallen to the Lot of ſome few at leaſt, ſome one of the ſtrong, and not only of the weak; the ſame hath been prov'd by the Inſtance of the Power given to the *Hedge-hog* and *Armadillo*, of contracting their Bodies into a globular Figure, and ſo hiding and ſecuring their tender and unarm'd Parts.

2. I ſhall prove by another eminent Inſtance that Things did not make Uſes, becauſe there is a Sort of Creatures which have all the Parts and Organs which are fitted for a certain Action, and employ'd for the Exerciſe of it by another Sort, and yet make no uſe of them for that purpoſe; that is, the Ape-Kind; the *Pariſian Academiſts* in their Anatomy of ſome Animals of this Kind tell us, that the Muſcles of the *Os Hyoides*, *Tongue*, *Larynx* and *Pharynx*, which do moſt ſerve to articulate a Word, were wholly like to thoſe of *Man*, and a great deal more than thoſe of the *Hand*, which nevertheleſs the *Ape*, which ſpeaks not, uſes with as much Perfection as a Man; which demonſtrates that Speech is an Action more peculiar to Man, and which more diſtinguiſhes him from Brutes than the *Hands*, which *Anaxagoras*, *Ariſtotle* and *Galen* have thought to be the Organ which Nature has given to Man as to the wiſeſt of all Animals, for want perhaps of this Reflection; for the *Ape* is found provided by Nature

ture of all those marvellous Organs of Speech with so much Exactness, that the very three small Muscles which do take their Rise from the *Apotheſis Styloides* are not wanting, altho' this *Apotheſis* be extremely small; this Particularity doth likewise shew that there is no reason to think that Agents do perform such and such Actions because they are found with Organs proper thereunto; for according to these Philosophers *Apes* should speak, seeing that they have all the Instruments necessary for Speech; all this is confirm'd and approv'd by the learned and accurate Dr. *Tyson* in his Anatomy of the *Orang-Outrang* or *Pigmy*, he finding in the Animal he describ'd (which was of the *Ape-Kind)* the whole Structure of the *Larynx* and *Os Hyoides* exactly as it is in Man; and the Reflection which the *Parisians* make upon their Observation of these and the neighbouring Parts, he thinks very just and valuable; and adds farther, that this is not the only Instance which may justify such an Inference, tho' he thinks it so strong an one as the *Atheists* can never answer.

It is farther considerable, and adds to the Weight of this Instance, that tho' Birds have been taught to imitate human Voice, and to pronounce Words, yea, Sentences; yet Quadrupeds never, tho' they have Organs far more fit for that purpose, and some of them, *viz. Dogs* and *Horses*, converse almost perpetually with Men; and others, as *Apes*, are given naturally to imitate Mens Actions, as if Providence had design'd purposely

to

to confute this fond Conceit of the *Atheists*, by denying them the Power to make use of these Organs of Speech, which, whether they understand what they said or not, they otherwise might and would have done in Imitation of Man, and that to greater Perfection than Birds do, or are capable of doing.

Farther, To prove that those *nobler Faculties* of the Soul, *Reason* and *Understanding*, cannot be produc'd by Matter organiz'd, but must have a higher Principle, * he thus argues: It is an Observation of *Vesalius*'s, that the Brain of Man, in respect of his Body, is much larger than what is to be met with in any other Animals, exceeding in Bigness three Oxes Brains; whence he infers, that as Animals excel in the Largeness of the Brain, so they do likewise in the principal Faculties of the Soul; which Inference the Doctor cannot allow.

* Dr. *Tyson.*

It is (saith he) a generally receiv'd Opinion, that the Brain is the immediate Seat of the Soul itself; whence one would be apt to think, that seeing there is so great a Disparity between the Soul of a *Man* and a *Brute*, the Organ in which it is plac'd should be very different too; yet, by comparing the Brain of our *Pigmy* [the *Orang-Outrang*, or *wild Man*] with that of a *Man*, and with the greatest Exactness observing each Part in both, it was very surprizing to me to find so great a Resemblance of the one to the other, as nothing

nothing could be more; and that in proportion to its Body its Brain was also as large as a *Man's*.

Since therefore (he proceeds) the Brain of our *Pigmy* doth in all Respects so exactly resemble a Man's, I might here make the same Reflection the *Parisians* did upon the *Organs* of *Speech*, that there is no reason to think that Agents do perform such and such Actions because they are found with *Organs* proper thereunto, for then our *Pigmy* might be really a *Man*; the *Organs* in *animal* Bodies are only a regular Compages of Pipes and Vessels for the *Fluids* to pass thro', and are passive; what actuates them are the *Humours* and *Fluids*, and *animal Life* consists in their due and regular Motion in this organical Body; but those *nobler Faculties* in the Mind of Man must certainly have a higher Principle, *or Matter organiz'd* could never produce them; for why else, where the *Organ* is the same, should not the *Action* be the same too?

Object. *Some may here object and argue: If the Body of Man be thus perfect, why did God make any other Animals? For the most perfect Being, the best, an infinitely good Agent, which wants neither Wisdom nor Power, should (one would think) only produce the most perfect.*

Answ. To which I answer: 1. That according to this Argumentation one might infer, that God must produce but one Kind of Creature, and that the

the moſt perfect that he is able, which is impoſſible; for he being infinite in all Perfection, cannot act *ad extremum virium*, unleſs he could produce an infinite Creature, that is, another God, which is a Contradiction; but whatever he makes muſt want Degrees of infinite Perfection, of which he could ſtill (if he pleas'd) add more and more to it.

2. The inferior Creatures are perfect in their Order and Degree, wanting no Quality or Perfection that is neceſſary or due to their Nature and Condition, their Place, and manner of living; now, why God might not make ſeveral ſubordinate Ranks and Degrees of Creatures, they being good, I ſee no reaſon.

3. Theſe ſeveral Ranks and Degrees of Creatures are ſubſervient one to another, and the moſt of them ſerviceable, and all ſome way or other uſeful to Man; ſo that he could not well have been without them.

4. God made theſe ſeveral Orders and Degrees, and in each Degree ſo many Varieties of Creatures, for the manifeſtation and diſplaying of his infinite Power and Wiſdom; for we have ſhewn before by a familiar Inſtance, that there is more Art and Wiſdom ſhewn in contriving and forming a Multitude of different Kinds of Engines than in one only.

5. Yet do I not think that he made all theſe Creatures to no other End but to be ſerviceable to Man, but alſo to partake themſelves of his overflowing Goodneſs, and to enjoy their own Beings. If we admit all other Creatures in this

inferior World beſides Man to be mere Machines or *Automata*, to have no Life, no Senſe nor Perception of any thing, then I confeſs this Reaſon is out of Doors, for being uncapable of Pleaſure or Pain they can have no Enjoyment; upon this account alſo, among others, I am leſs inclinable to that Opinion.

I ſhould now proceed to anſwer ſome Objections which might be made againſt the Wiſdom and Goodneſs of God in the Contrivance and Governance of the World, and all Creatures therein contain'd; but that is too great and difficult a Taſk for my Weakneſs, and would take up more Time than I have at preſent to ſpare were I qualify'd for it, and beſides ſwell this Volume to too great a Bulk; only I ſhall ſay ſomething to one Particular which was ſuggeſted to me by a learned and pious * Friend.

* Mr. *Robert Burſcough* of *Totneſs*, in *Devon.*

Object. *A wiſe Agent acts for Ends. Now what End can there be of creating ſuch a vaſt Multitude of Inſects as the World is fill'd with, moſt of which ſeem to be uſeleſs, and ſome alſo noxious and pernicious to Man and other Creatures?*

Anſw. To this I ſhall anſwer: 1. As to the Multitude of *Species* or Kinds. 2. As to the Number of *Individuals* in each Kind.

Firſt, As to the Multitude of *Species* (which we muſt needs acknowledge to be exceeding great, they being not fewer, perchance more

more than Twenty Thousand.) I answer, there were so many made,

1. To manifest and display the Riches of the Power and Wisdom of God, *Psalm* civ. 24. *The Earth is full of thy Riches, so is the great and wide Sea, wherein are Things creeping innumerable,* &c. We should be apt to think too meanly of those Attributes of our Creator, should we be able to come to an End of all his Works, even in this sublunary World; and therefore I believe never any Man yet did, never any Man shall so long as the World endures, by his utmost Industry attain to the Knowledge of all the *Species* of Nature; hitherto we have been so far from it, that in Vegetables the Number of those which have been discover'd this last Age hath far exceeded that of all those which were known before; so true is that we quoted before out of *Seneca: Pusilla res est mundus, nisi in eo quod quærat omnis, mundus habeat.* The World is so richly furnish'd and provided, that Man need not fear want of Employment should he live to the Age of *Methuselah*, or ten times as long; but of this, having touch'd it already, I shall add no more.

2. Another reason why so many Kinds of Creatures were made, might be to exercise the contemplative Faculty of Man, which is in nothing so much pleas'd as in variety of Objects; we soon grow weary of one Study, and if all the Objects of the World could be comprehended by us, we should with *Alexander* think the World too little for us, and grow weary of running in a Round of

ſeeing the ſame Things; new Objects afford us great Delight, eſpecially if found out by our own Induſtry. I remember *Cluſius* ſaith of himſelf, "That upon the Diſcovery of a new Plant he "did not leſs rejoice than if he had found a rich "Treaſure." Thus God is pleas'd, by reſerving things to be found out by our Pains and Induſtry, to provide us Employment moſt delightful and agreeable to our Natures and Inclinations.

3. Many of theſe Creatures may be uſeful to us whoſe Uſes are not yet diſcover'd, but reſerv'd for the Generations to come, as the Uſes of ſome we now know are but of late Invention, and were unknown to our Forefathers; and this muſt needs be ſo, becauſe, as I ſaid before, the World is too great for any Man or Generation of Men, by his or their utmoſt Endeavours, to diſcover and find out all its Store and Furniture, all its Riches and Treaſures.

Secondly, As to the Multitude of Individuals in each Kind of *Inſect*. I anſwer:

1. It is deſign'd to ſecure the Continuance and Perpetuity of the ſeveral Species, which if they did not multiply exceedingly, ſcarce any of them could eſcape the Ravine of ſo many Enemies as continually aſſault and prey upon them, but would be in danger to be quite deſtroy'd and loſt out of the World.

2. This vaſt Multitude of Inſects is uſeful to Mankind, if not immediately, yet mediately. It cannot be deny'd that Birds are of great Uſe to us, their Fleſh affording us a good Part of our Food, and that the moſt delicate too, and their other Parts Phyſick, not excepting their very Excrements; their Feathers ſerve to ſtuff our Beds and Pillows, yielding us ſoft and warm Lodging, which is no ſmall Convenience and Comfort to us, eſpecially in theſe northern Parts of the World; ſome of them have alſo been always employ'd by military Men in Plumes, to adorn their Creſts, and render them formidable to their Enemies; their Wings and Quills are made uſe of for writing-Pens, and to bruſh and cleanſe our Rooms, and their Furniture; beſides, by their melodious Accents they gratify our Ears; by their beautiful Shapes and Colours they delight our Eyes, being very ornamental to the World, and rendring the Country, where the Hedges and Woods are full of them, very pleaſant and chearly, which without them would be no leſs lonely and melancholy; not to mention the Exerciſe, Diverſion and Recreation which ſome of them give us.

Now Inſects ſupply Land Birds with the chiefeſt Part of their Suſtenance; ſome, as the entire *Genus* of *Swallows*, live wholly upon them, as I could eaſily make out did any Man deny or doubt of it; and not *Swallows* alone, but alſo *Wood-peckers*, if not wholly, yet chiefly; and all other Sorts of Birds partly, eſpecially in Winter-time, as appears by diſſecting their Stomachs.

As for young Birds which are brought up in the Neſt by the old, they are fed chiefly if not ſolely by Inſects; and therefore for the time when Birds for the moſt part breed, in the Spring, when there are Multitudes of Caterpillars to be found on all Trees and Hedges; moreover, it is very remarkable, that of many ſuch Birds as when grown up feed almoſt wholly upon Grain, the young ones are nouriſh'd by Inſects; for example, *Pheaſants* and *Partridges*, which are well known to be granivorous Birds, the Young live only or moſtly upon Ants Eggs. Now Birds, being of a hot Nature, are very voracious Creatures, and eat abundantly, and therefore there had need be an infinite Number of Inſects produc'd for their Suſtenance. Neither do Birds alone, but many Sorts of Fiſhes, feed upon Inſects, as is well known to Anglers, who bait their Hooks with them; nay, which is more ſtrange, divers Quadrupeds feed upon Inſects, and ſome live wholly upon them, as two Sorts of *Tamunduus* upon Ants, which therefore are call'd in *Engliſh* Ant-Bears; the *Camelion* upon Flies; the Mole upon Earth-worms; the *Badger* alſo lives chiefly upon Beetles, Worms, and other Inſects.

Here we may take notice by the way, that becauſe ſo many Creatures live upon Ants and their Eggs, Providence hath ſo order'd it, that they ſhould be the moſt numerous of any Tribe of Inſects that we know.

Confor-

Conformable to this Particular is the Reaſon my ingenious and inquiſitive Friend Mr. *Derham*, before remember'd, hath given of the Production of ſuch innumerable Multitudes of ſome aquatick Inſects.

I have often thought (ſaith he) that there was ſome more than ordinary Uſe in the Creation for ſuch Inſects as are vaſtly numerous, ſuch as the *Pulices aquatici*, which are in ſuch Swarms as to diſcolour the Waters, and many others; and therefore I have bent my Enquiries to find out the Uſes of ſuch Creatures, wherein I have ſo far ſucceeded, as to diſcover, that thoſe vaſtly ſmall *Animalcula*, not to be ſeen without a Microſcope, with which the Waters are replete, ſerve for Food to ſome others of the ſmall Inſects of the Water, particularly to the *Nympha Culicaria* [*Hirſuta* it may be call'd] figur'd in *Swammerdam*; for viewing that *Nympha* one Day, to obſerve the motion of its Mouth, and for what purpoſe it is in ſuch continual motion, whether as Fiſh to get Air, or to ſuck in Food, or both, I could plainly perceive the Creature to ſuck in many of the moſt minute *Animalcula*, that were ſwimming briſkly about in the Water; neither yet do theſe *Animalcules* ſerve only for Food to ſuch *Nymphæ*, but alſo to another, to me anonymous Inſect of the Waters, of a dark Colour, cleft as it were in ſunder, and ſcarce ſo big as the ſmalleſt Pin's Head; theſe Inſects hunt theſe *Animalcules*, and other ſmall Creatures that occur in the Water, and devour them; and I am apt to think, altho' I have not yet ſeen it,

that the *Pulex aquaticus arboreſcens* liveth upon theſe, or more minute and tender *Animalcules*, and that it is to catch them that it ſo leaps in the Water.

This to me ſeems a wonderful Work of God, to provide for the minuteſt Creatures of the Waters Food proper for them, that is, minute and tender, and fit for their Organs of ſwallowing.

As for noxious Inſects, why there ſhould be ſo many of them produc'd, if it be demanded,

I anſwer, 1. That many that are noxious to us, are ſalutary to other Creatures; and ſome that are Poiſon to us, are Food to them. So we ſee the Poultry-Kind feed upon *Spiders*; nay, there is ſcarce any noxious Inſect but one Bird or other eats it, either for Food or Phyſick; for many, nay, moſt of thoſe Creatures whoſe Bite or Sting is poiſonous, may ſafely be taken entire into the Stomach; and therefore it is no Wonder that not only the *Ibis* of *Egypt*, but even *Storks* and *Peacocks*, prey upon and deſtroy all Sorts of *Serpents* as well as *Locuſts* and *Caterpillars*.

2. Some of the moſt venomous and pernicious of Inſects afford us noble Medicines, as *Scorpions*, *Spiders*, and *Cantharides*.

3. Theſe Inſects ſeldom make uſe of their offenſive Weapons, unleſs aſſaulted or provok'd in their own Defence, or to revenge an Injury; let them

them but alone, and annoy them not, nor disturb their Young, and, unless accidentally, you shall seldom suffer by them.

Lastly, God is pleas'd sometimes to make use of them as Scourges, to chastize or punish wicked Persons or Nations, as he did *Herod* and the *Egyptians*; no Creature so mean and contemptible, but God can when he pleases produce such Armies of them, as no human Force is able to conquer or destroy, but they shall of a sudden consume and devour up all the Fruits of the Earth, and whatever might serve for the Sustenance of Man, as *Locusts* have often been observ'd to do.

Did these Creatures serve for no other Use, as they do many, yet those that make them an Objection against the Wisdom of God, may (as Dr. *Cockburn* well notes) as well upbraid the Prudence and Policy of a State for keeping Forces, which generally are made up of very rude and insolent People, which yet are necessary, either to suppress Rebellions, or punish Rebels, and other disorderly and vicious Persons, and keep the World in Quiet.

From that Part of this Discourse which relates to the Body of Man, I shall make these practical Inferences.

Infer. 1. *First*, Let us give Thanks to Almighty God for the Perfection and Integrity of our Bodies; it would not be amiss to put it into the eucharistical Part of our daily Devotions: We praise thee, O God, for the due Number, Shape, and Use of our Limbs and Senses; and in general, of all the Parts of our Bodies; we bless thee for the sound and healthful Constitution of them, *Psal.* x. *It is thou that hast made us, and not we ourselves; in thy Book were all our Members written.* The Formation of the Body is the Work of God, and the whole Process thereof attributed to him, *Psal.* cxxix. 13, 14, 15. The Mother that bears the Child in her Womb is not conscious to any thing that is done there, she understands no more how the Infant is form'd than itself doth; but if God hath bestow'd upon us any peculiar Gift or Endowment wherein we excel others, as Strength, or Beauty, or Activity, we ought to give him special Thanks for it; but not to think the better of ourselves therefore, or despise them that want it.

Now because these bodily Perfections being common Blessings, we are apt not at all to consider them, or not to set a just Value on them; and because the Worth of Things is best discern'd by their want, it would be useful sometimes to imagine or suppose ourselves, by some Accident, to be depriv'd of one of our Limbs or Senses, as a Hand, or a Foot, or an Eye, for then we cannot

not but be ſenſible that we ſhould be in worſe Condition than now we are, and that we ſhould ſoon find a difference between two Hands and one Hand, two Eyes and one Eye, and that two excel one as much in Worth as they do in Number; and yet, if we could ſpare the Uſe of the loſt Part, the Deformity and Unſightlineſs of ſuch a Defect in the Body would alone be very grievous to us. Again, which is leſs, ſuppoſe we only that our Bodies want of their juſt Magnitude, or that they or any of our Members are crooked or diſtorted, or diſproportionate to the reſt, either in Exceſs or Defect; nay, which is leaſt of all, that the due Motion of any one Part be perverted, as, but of the Eyes in ſquinting, the Eye-lids in twinkling, the Tongue in ſtammering, theſe things are ſuch Blemiſhes and Offences to us, by making us Gazing-ſtocks to others, and Objects of their Scorn or Deriſion, that we could be content to part with a good Part of our Eſtates to repair ſuch Defects or heal ſuch Infirmities. Theſe things conſider'd, and duly weigh'd, would ſurely be a great and effectual Motive to excite in us Gratitude for this Integrity of our Bodies, and to eſteem it no ſmall Bleſſing, I ſay, a Bleſſing and Favour of God to us; for ſome there be that want it, and why might not we have been of that Number? God was no way oblig'd to beſtow it upon us.

And

And as we are to give Thanks for the Integrity of our Body, so are we likewise for the Health of it, and sound Temper and Constitution of all its Parts and Humours; Health being the principal Blessing of this Life, without which we cannot enjoy or take Comfort in any things beside.

Neither are we to give Thanks alone for the first Collation of these Benefits, but also for their Preservation and Continuance. God preserves our Souls in Life, and defends us from Dangers and sad Accidents, which do so beset us on every side, that the greatest Circumspection in the World could not secure us, did not his good Providence continually watch over us; we may be said to walk and converse in the midst of Snares; besides, did we but duly consider the Make and Frame of our Bodies, what a multitude of minute Parts and Vessels there are in them, and how an Obstruction in one redounds to the Prejudice of the whole, we could not but wonder how so curious an Engine as Man's Body could be kept in Tune one Hour as we use it, much less hold out so many Years; how it were possible it should endure such Hardships, such Blows, so many Shocks and Concussions, nay, such Violences and Outrages as are offer'd it by our frequent Excesses, and not be disorder'd and render'd useless; and acknowledge the transcendent Art and Skill of him who so put it together, as to render it thus firm and durable.

Infer. 2.

Infer. 2. *Secondly*, Have a care thou doſt not by any vicious Practice deface, marr, or deſtroy the Workmanſhip of God; ſo uſe this Body as to preſerve the Form and Comelineſs, the Health and Vigor of it.

1. For the Form and Beauty of the Body, which Mankind generally is fond enough of, and which muſt be acknowledg'd to be a natural Endowment and Bleſſing of God, a thing deſirable, which all Men take Complacency in, which renders Perſons gracious and acceptable in the Eyes of others; of which yet we do not obſerve that brute Beaſts take any notice at all: Of this I ſhall obſerve, that outward Beauty is a ſign of inward; and that handſome Perſons are naturally well inclin'd, till they do either debauch themſelves, or are corrupted by others, and then with their Manners they marr their Beauty too; for a Man may obſerve, and eaſily diſcern, that as Perſons are better or worſe inclin'd, the very Air of their Viſage will alter much; and that vicious Courſes, *defacing the inward Pulchritude of the Soul, do change even the outward Countenance into an abhorr'd Hue* *; as is evident in the Vices of Intemperance and Anger, and may, by ſagacious Perſons, be obſerv'd in others alſo. No better Coſmeticks than a ſevere Temperance and Purity, a real and unaffected Modeſty and Humility, a gracious Temper and Calmneſs

* Dr. More.

Calmneſs of Spirit, a ſincere and univerſal Charity; no true Beauty without the Signatures of theſe Graces in the very Countenance; they therefore who thro' the contrary Vices do deface and blot out this natural Character and Impreſs, and do Violence to their own Inclinations, that ſacrifice this Jewel to their Luſts, that reject this Gift of God, and undervalue the Favour of Man, aggravate their Sin and Miſery, and purchaſe Hell at ſomewhat a dearer Rate than others do; and thoſe that have but a mean Portion of this Gift, are the more oblig'd by virtuous Practices, not only to preſerve, but to improve it. Virtue (as *Cicero* obſerves) if it could be ſeen with corporeal Eyes, *admirabiles ſui Amores excitaret*; *it would excite a wonderful Love of itſelf.* By the Signatures it there impreſſes, it is in ſome meaſure viſible in the Faces of thoſe that practiſe it, and ſo muſt needs impart a Beauty and Amiableneſs to them.

Diogenes Laertius, in the Life of *Socrates*, tells us, that the Philoſopher was wont to adviſe young Men, συνέχὲς κατοπτεύεσθαι, often to behold themſelves in their Looking-Glaſſes or Mirrors. Grammercy, *Socrates*, that is good Counſel indeed! will our young Gentlemen and Ladies be ready to ſay: We like it very well, and we practiſe accordingly: And it ſeems we are injuriouſly tax'd and reprehended by

by Divines for ſpending ſo much Time between a Comb and a Glaſs. Be not over haſty, take what remains along with you: Mark the End for which the Philoſopher exhorts this, Ἵν' εἰ μὲν καλοὶ εἶεν, ἀξιοι γίγνοιντο, εἰ δ' αἰσχεῖ παιδείᾳ τὴν δυσείδειαν ἐπικαλύπτοιεν, *That if they be handſome, they might approve themſelves worthy of their Form; but if they be otherwiſe, they may by Diſcipline and Inſtitution hide their Deformity*; and ſo by their virtuous Behaviour compenſate the Hardneſs of their Favour, and by the Pulchritude of their Souls make up what is wanting in the Beauty of their Bodies; and truly I believe a virtuous Soul hath Influence upon its Vehicle, and adds a Luſtre even to the outward Man, ſhining forth in the very Face.

2. So uſe the Body as to preſerve the Health and Vigor, and conſequently prolong the Life of it; theſe are Things that all Men covet; no more effectual Means for the Maintenance and Preſervation of them than a regular and virtuous Life. That Health is impair'd by Vice, daily Experience ſufficiently evinceth; I need not ſpend Time to prove what no Man doth or can deny. And as for Length of Days, we find by the ſame Experience, that intemperate and diſorderly Perſons are, for the moſt part, ſhort-liv'd; moreover, immoderate Cares and Anxiety are obſerv'd ſuddenly to bring grey Hairs

Hairs upon Men, which are usually the Signs and Forerunners of Death; and therefore the way to live long must needs be in all Points to use our Bodies so as is most agreeable to the Rules of Temperance, and Purity, and right Reason; every Violence offer'd to it weakens and impairs it, and renders it less durable and lasting. One Means there is which Physicians take notice of as very effectual for the Preservation of Health, which I cannot here omit, that is, a quiet and chearful Mind, not afflicted with violent Passions, or distracted with immoderate Cares, for these have a great and ill Influence upon the Body; now, how a Man can have a quiet and chearful Mind under a great Burden and Load of Guilt, I know not, unless he be very ignorant, or have a sear'd Conscience; it concerns us therefore, even upon this Account, to be careful of our Conversation, and to keep our Consciences void of Offence both toward God and toward Men.

Infer. 3. *Thirdly*, Did God make the Body? let him have the Service of it, *Rom.* xii. 1. *I beseech you, Brethren, by the Mercies of God, that you present your Bodies a living Sacrifice, holy, acceptable unto God, which is your reasonable Service.* How we should do that, St. *Chrysostom* tells us in his Commentary upon this Place,

Μηδὲν

Μηδὲν ὀφθαλμὸς πονηρὸν βλεπέτω, καὶ γέγονε θυσία· μηδὲν ἡ γλῶσσα λαλείτω αἰσχρὸν, καὶ γέγονε προσφορά· μηδὲν ἡ χεὶρ πραττέτω ἀθέμιτον, καὶ γέγονεν ὁλοκαύτωμα, &c. *Let the Eye behold no evil thing, and it is made a Sacrifice; let the Tongue ſpeak no filthy Word, and it becomes an Oblation; let the Hand do no unlawful Action, and you render it a Holocauſt. Yet it is not enough thus to reſtrain them from Evil, but they muſt alſo be employ'd and exercis'd in doing that which is good; the Hand in giving Alms, the Tongue in bleſſing them that curſe us and deſpitefully uſe us; the Ear in hearkening to divine Lectures and Diſcourſes.* 1 Cor. vi. 20. *Glorify God in your Body, or with your Body, and in your Spirit, which are God's*; and that not by Redemption only, of which the Apoſtle there ſpeaks, but by Creation alſo: *Rom.* vi. 13. *Neither yield ye your Members as Inſtruments of Unrighteouſneſs unto Sin, but as Inſtruments of Righteouſneſs unto God.* And again, *ver.* 19. *Even ſo now yield your Members Servants of Righteouſneſs unto Holineſs.* I ſhall inſtance in two Members, which are eſpecially to be guarded and reſtrain'd from Evil, and employ'd in the Service of God.

Firſt, The *Eye*. We muſt *turn away our Eyes from beholding Vanity*, as *David* pray'd God would his, *Pſal.* cxix. 37. We muſt *make a Covenant with our Eyes*, as *Job* did, *Job* xxxi. 1. Theſe

These are the Windows that let in exterior Objects to the Soul; by these the Heart is affected; this way Sin enter'd first into the World; our first Parent saw that *the Tree* and its Fruit *was pleasant to the Eyes*, and so was invited to take and eat it. There are four Sins especially for which the Eye is noted, as either discovering themselves in the Eyes, or whose Temptations enter in by, and so give Denomination to the Eye.

1. There is a *proud Eye*, Prov. xxx. 13. *There is a Generation, O how lofty are their Eyes! And their Eye-lids are lifted up*, Chap. vi. 17. *A proud Look* is reckon'd the first of those six things that God hates, *Psal.* xviii. 27. *God* (the *Psalmist* saith) *will bring down proud or high Looks.* Psal. ci. 5. *Him that hath a high Look and a proud Heart* (saith *David*) *I will not suffer.* And in *Psalm* cxxxi. 1. he saith of himself, that *his Heart is not haughty, nor his Eyes lofty.* By which Places it appeareth that Pride sheweth forth itself in the Eyes especially, and that they are as it were the Seat or Throne of it.

2. There is a *wanton Eye*, which the Prophet *Isaiah* speaks of in his third Chapter, at the 16th Verse, *Because the Daughters of Jerusalem walk with stretched-out Necks and wanton Eyes.* The Apostle St. *Peter*, in his Second Epistle, Chap. ii. 24. mentions *Eyes full of Adultery*; for by these Casements enter in such Objects as

may provoke and ſtir up adulterous Thoughts in the Mind, as they did in *David*'s; and likewiſe impure Thoughts conceiv'd in the Heart, may diſcover themſelves by the Motions of the Eye; and therefore in this reſpect we ſhould do well, with holy *Job*, to make a Covenant with our Eyes, not to gaze upon any Object which may tempt us to any inordinate Appetite or Deſire; for our Saviour tells us, it were better to pluck out our Right Eye than that it ſhould be an Offence to us; which I ſuppoſe refers to this Matter, becauſe it immediately follows thoſe Words, *He that looketh upon a Woman to luſt after her, hath already committed Adultery with her in his Heart.*

3. There is a *covetous Eye.* By Covetouſneſs I underſtand, not only a deſiring what is another Man's, which is forbidden in the Tenth Commandment, but alſo an inordinate Deſire of Riches, which the Apoſtle St. *John* ſeems to underſtand in his firſt Epiſtle, *Chap.* ii. 16. *by the Luſt of the Eye.* And Covetouſneſs may well be call'd *the Luſt of the Eye*, becauſe, 1. The Temptation or tempting Object enters by the Eye; ſo the ſeeing the Wedge of Gold and *Babyloniſh* Garment ſtirr'd up the covetous Deſire in *Achan.* 2. Becauſe all the Fruit a Man reaps of Riches, more than will furniſh his Neceſſities and Conveniences, is the feeding of his Eye, or the Pleaſure he takes in the beholding of them, *Eccleſ.* v. 11.

When Goods increaſe, &c. *what Good is there to the Owners thereof, ſaving the beholding them with their Eyes?*

4. There is an *envious Eye*, which by our Saviour is call'd an evil Eye, *Matth.* xx. 15. *Is thine Eye evil becauſe I am good?* That is, envieſt thou thy Brother becauſe I am kind to him? And *Chap.* vii. 22. one of thoſe evil things which proceed out of the Heart and defile a Man, is *an evil Eye.* Envy is a repining at the Proſperity or Good of another, or Anger and Diſpleaſure at any Good of another which we want, or any Advantage another hath above us; as in the Parable of the Labourers in the Vineyard, thoſe that came in firſt envy'd the laſt, not becauſe they receiv'd more than they, but becauſe they receiv'd equal Wages for leſs Time; thoſe that are ſubject to this Vice cannot endure to ſee another Man thrive, and are apt to think his Condition better than theirs, when indeed it is not.

Let us then ſo govern our Eyes that we diſcover by them none of theſe Vices; let the Humility and Purity of our Minds appear even in our outward Looks; let neither Pride nor Luſt manifeſt themſelves in the Poſture or Motions of our Eyes; let us have a care that theſe Members be neither the Inlets nor Outlets of any of the forementionʼd Vices, that they neither give Admiſſion to the Temptation, nor be expreſſive of the Concep-

Conception of them; let us employ them in reading the Word of God and other Books, for the Increaſe of our Knowledge and Direction of our Practice; in diligently viewing and contemplating the Works of the Creation, that we may diſcern and admire the Footſteps of the divine Wiſdom, eaſily to be trac'd in the Formation, Diſpoſition, and Deſignations of them; let us take notice of any extraordinary Events and Effects of God's Providence towards ourſelves or others, perſonal or national, that as they are the Iſſues of his Mercy or Juſtice, they may ſtir up ſuitable Affections in us of Thankfulneſs or Fear; let thoſe ſad and miſerable Objects that preſent themſelves to our Sight move us to Pity and Commiſeration; and let our Eyes ſometimes be exercis'd in weeping for the Miſeries and Calamities of others, but eſpecially for our own and their Sins.

Secondly, Another Member I ſhall mention is, the *Tongue*, which as it is the chief Inſtrument of Speech, ſo it may be well or ill employ'd in the Exerciſe of that Action, and therefore ſtands in need of Direction and Reſtraint. I remember I once heard from an ingenious *Anatomiſt* of *Padua* this Obſervation, that there are but two Members in the Body that have a natural Bridle, both which do very much need it; the Tongue, and another I ſhall not name; the Signification whereof may be, that they are not to be let looſe, but diligently curb'd and held in. That the Tongue

needs a Bridle, you will readily grant, if you read what the Apoſtle St. *James* hath written of it, Chap. iii. 6. *The Tongue is a fire, a world of Iniquity: ſo is the Tongue among our Members, that it defileth the whole Body, and ſetteth on fire the courſe of Nature, and is ſet on fire of Hell. For every Kind of Beaſts, and of Birds, and of Serpents, and of things in the Sea, is tamed, and hath been tamed of Mankind; but the Tongue can no Man tame, it is an unruly Evil, full of deadly Poiſon.* For the better Government of the Tongue, I ſhall note ſome Vices of Speech which muſt carefully be avoided; firſt of all, *Loquacity* or *Garrulity*; this the Contrivance of our Mouths ſuggeſts to us; our Tongues are fenced and guarded with a double Wall or Mound of Lips and Teeth, that our Words might not raſhly and unadviſedly ſlip out; then Nature hath furniſh'd us with two Ears and but one Tongue, to intimate that we muſt hear twice ſo much as we ſpeak. Why *Loquacity* is to be avoided the wiſe Man gives us a ſufficient Reaſon, *Prov.* x. 19. *In the multitude of words there wanteth not Sin.* And, *Eccleſ.* v. 7. *In many words there are divers vanities.* To which we may add another, of great Force with moſt Men, *viz.* that it hath been always eſteem'd an Effect and Argument of Folly, *Eccleſ.* v. 3. *A Fool's Voice is known by multitude of Words.* And on the contrary, to be of few Words is a Sign of Wiſdom; and he that is wiſe enough to be ſilent, tho' a Fool, may paſs undiſcover'd; beſides all this,

a talkative

a talkative Person must needs be impertinent, and speak many idle Words, and so render himself burdensome and odious to Company, and may perchance run himself upon great Inconveniences, by blabbing out his own or others Secrets; for a Word once utter'd, *fugit irrevocabile*, is irrevocable, whatever the Consequence of it be; great need therefore have we *to set a Watch over our Mouths, and to keep the Door of our Lips*, Psal. cxli. 3. and not suffer our Tongues * προτρέχειν τῆς διανοίας as *Isocrates* phraseth it.

* *Run before the Understanding or Wit.*

Secondly, Lying, or false speaking. There is difference between *mentiri* and *mendacium dicere*, that is, lying, and speaking of an Untruth, or a thing that is false. *Mentiri*, is *contra mentem ire*, which, though it be no good Etymology of the Word, is a good Notion of the thing; that is, to go against one's Mind, or speak what one does not think.

Ἕτερον μὲν κεύθειν ἐνὶ φρεσὶν, ἄλλο δὲ βάζειν.

As *Homer* expresses it, to conceal one thing in the Mind, and speak another with the Tongue; hence a Man may speak an Untruth and yet not lie, when he thinks he speaks the Truth; and

on the contrary, may ſpeak what is materially true and yet lie, when he ſpeaks what he thinks not to be true. The Tongue was made to be the *Index* of the Mind, Speech the Interpreter of Thought, therefore there ought to be a perfect Harmony and Agreement between theſe two; ſo that lying is a great Abuſe of Speech, and a perverting the very End of it, which was to communicate our Thoughts one to another; it hath alſo an ill Principle for the moſt part, proceeding either from *Baſeneſs of Spirit*, or *Cowardice*, as in them that have committed a Fault, and deny it for fear of Puniſhment or Rebuke; and therefore the ancient *Perſians*, as *Xenophon* tells us in his Κύρε παιδέα, made it one of the three things they diligently taught their Children, which were ἱππεύειν, καὶ τοξεύειν, καὶ ἀληθεύειν· *to Ride*, *to Shoot*, and *to ſpeak the Truth:* Or from *Covetouſneſs*, as in Tradeſmen, who falſly commend their Commodities, that they may vend them for a greater Price; or from *Vanity* and *Vain-glory*, in them who falſly boaſt of any Quality or Action of their own. It is odious both to God and Man; to God, *Prov.* vi. 17. *A lying Tongue* is one of thoſe ſix or ſeven things that are an *Abomination to him*; to Men, as *Homer* witneſſeth in the Verſe preceding the fore-quoted.

Ἐχθρὸς

Ἐχθρὸς γὰρ μοι κεῖνος ὁμῶς Ἀΐδαο πύλῃσι, &c.

He that tells Lies is as hateful to me as the Gates of Hell or Death. —— The Practice of lying is a diabolical Exercise, and they that use it are the Devil's Children, as our Saviour tells us, *John* viii. 44. *Ye are of your Father the Devil*, &c. *for he is a Liar, and the Father of it.* And, lastly, it is a Sin that excludes out of Heaven, and depresses the Soul into Hell. *All Liars shall have their Part in the Lake which burns with Fire and Brimstone, which is the second Death.*

Thirdly, Another Vice, or Abuse of Speech, or vicious Action, to which the Tongue is instrumental, is *Slandering*; that is, raising a false Report of any Man, tending to his Defamation; this might have been comprehended under the former Head, being but a kind of lying, proceeding from Enmity or Ill-will; it is a very great Injury to our Neighbour, Mens Reputation being as dear to them as Life itself; so that it is grown to be a Proverb among the Vulgar, *Take away my good Name and take away my Life.* And that which enhanses this Injury is, that it is irreparable; we cannot, by any contrary Declaration, so clear the Innocency of our Neighbour, as wholly to extirpate the pre-conceiv'd Opinion out of the Minds of those to whom our Confession comes; and many will remain whom the

Calumny hath reach'd, to whom the Vindication probably will not extend, the Pravity of Man's Nature being more apt to ſpread and divulge an ill Report than to ſtop and ſilence it. I might inſtance in flattering of others and boaſting of ourſelves, for two Abuſes of Speech, but they may both be referr'd to lying, the one to pleaſe others, and puff them up with Self-conceit, and a falſe Opinion, that they have ſome excellent Quality or Endowment, which they want, or have not in ſuch a degree, or that they are better thought of by others than indeed they are, and more honour'd; the other, to gain more Honour than is due to ourſelves. Neither yet is boaſting only of what we have not, but alſo what we have, condemn'd and diſallow'd by God and Men, as being contrary to that Humility and Modeſty that ought to be in us, *Prov.* xxvii. 2. *Let another Man praiſe thee, and not thine own Mouth; a Stranger, and not thine own Lips.* And Moraliſts proceed ſo far as to cenſure all unneceſſary περιαυτολογία, that is, talking of a Man's ſelf.

Fourthly, Obſcene and impure Words are another vicious Effect of the Tongue; thoſe are principally the σαπροὶ λόγοι, rotten Speeches the Apoſtle ſpeaks of, *Eph.* v. 29. ſuch as chaſte Ears abhor, which tend only to the depraving and corrupting the Hearers, and are to be ſtudiouſly

and carefully avoided by all that pretend to Chriſtianity, *Eph.* v. 3. *But Fornication, and all Uncleanneſs, let it not be once nam'd among you.*

Fifthly, Curſing, and railing or reviling Words, are alſo a great Abuſe of Speech, and outrageous Effects and Expreſſions of Malice and Wickedneſs; *Pſal.* x. 7. The *Pſalmiſt* makes it Part of the Character of a wicked Man, that *his Mouth is full of Curſing*; which Paſſage we have quoted by the Apoſtle, *Rom.* iii. 14. *whoſe Mouth is full of Curſing and Bitterneſs.*

Sixthly, Swearing, and irreverently uſing the Name of God in common Diſcourſe and Converſe, is another Abuſe of the Tongue; to which I might add, vehement Aſſeverations upon ſlight and trivial Occaſions. I do not deny, but in a Matter of weight and moment, which will bear out ſuch Atteſtation, and where Belief will not be obtain'd without them, and yet it may much import the Hearer or Speaker that his Words be believ'd, or where the Hearer would not otherwiſe think the Matter ſo momentous or important as indeed it is, Proteſtations and Aſſeverations, yea, Oaths, may lawfully be us'd; but to call God to witneſs to an Untruth, or a Lie perhaps, or to appeal to him on every trivial Occaſion in common Diſcourſe, cuſtomarily, without any

any Consideration of what we say, is one of the highest Indignities and Affronts that can be offer'd him, being a Sin to which there is no Temptation; for it is so far from gaining Belief (which is the only thing that can with any shew of Reason be pleaded for it) that it rather creates Diffidence and Distrust; for as *multa fidem promissa levant*, so *multa juramenta* too; it being become a Proverb, *He that will swear will lye*; and good reason there is for it, for he that scruples not the Breach of one of God's Commands, is not likely to make Conscience of the Violation of another.

Lastly, (for I will name no more) scurrilous Words, scoffing and jeering, flouting and taunting, are to be censur'd as vicious Abuses of Speech.

This Scoffing and Derision proceeds from Contempt, and that of all Injuries Men do most impatiently bear, nothing offends more or wounds deeper; and therefore what greater Violation of that general Rule of Christian Practice, *to do to others as we would they should do unto us?* This Injury of being derided the *Psalmist* himself complains of, *Psal.* lxix. 11, 12. *I became a Proverb to them. They that sit in the Gate speak against me, and I was the Song of the Drunkards.* And *Psal.* xxxv. 15. according to the Church Translation, *The very Abjects came together against me unawares, making Mows at me, and ceased not.* And the Prophet

Prophet *Jeremy*, Jer. xx. 7. *I am in Derision daily, every one mocketh me.* And tho' there may be some Wit shewn in scoffing and jesting upon others, yet is it a Practice inconsistent with true Wisdom. The Scorner and the Wise Man are frequently oppos'd in Scripture, *Prov.* ix. 8. and *Chap.* xiii. 1, *&c.* It is a proverbial Saying, *The greatest Clerks are not always the wisest Men.* I think the Saying might as often be verify'd of the greatest *Wits*. Scorning, in that Gradation in the first *Psalm*, is set down as the highest Step of Wickedness. And *Solomon* tells us, *that Judgments are prepar'd for the Scorners.*

You will say to me, how then must our Tongues be employ'd? I answer, 1. In Praises and Thanksgiving unto God, *Psal.* xxxv. 28. *And my Tongue shall speak of thy Righteousness and of thy Praises all the Day long.* Parallel whereto is *ver.* 24. of *Psal.* lxxi. Indeed the Book of *Psalms* is in a great measure but an Exercise of or Exhortation to this Duty. 2. We must exercise our Tongues in talking of all his wondrous Works: *Psal.* cxlv. 5, 6. *I will speak of the glorious Honour of thy Majesty, and of thy wondrous Works.* 3. In Prayer to God. 4. In Confession of him and his Religion, and publickly owning it before Men, whatever the Hazard be. 5. In teaching, instructing, and counselling of others, 6. In exhorting them. 7. In comforting them that need it. 8. In reproving them. All which

Parti-

Particulars I might enlarge upon, but becauſe they come in here only as they refer to the Tongue, it may ſuffice to have mention'd them ſummarily.

Thirdly, Let us hence learn duly to prize and value our Souls. Is the Body ſuch a rare Piece, what then is the Soul? The Body is but the Huſk or Shell, the Soul is the Kernel; the Body is but the Caſk, the Soul the precious Liquor contain'd in it; the Body is but the Cabinet, the Soul the Jewel; the Body is but the Ship or Veſſel, the Soul the Pilot; the Body is but the Tabernacle, and a poor Clay Tabernacle or Cottage too, the Soul the Inhabitant; the Body is but the Machine or Engine, the Soul that ἐνδὸν πν, that actuates and quickens it; the Body is but the dark Lantern, the Soul or Spirit is the Candle of the Lord that burns in it: And ſeeing there is ſuch difference between the Soul and the Body in reſpect of Excellency, ſurely our better Part challenges our greateſt Care and Diligence to make Proviſion for it. Bodily Proviſion is but half Proviſion, it is but for one Part of a Man, and that the meaner and more ignoble too, if we conſider only the Time of this Life; but if we conſider a future Eſtate of endleſs Duration after this Life, then bodily Proviſion will appear to be, I do not ſay, quarter Proviſion, but no Proviſion at all in compariſon, there being no Proportion between

tween so short a Period of Time and the infinite Ages of Eternity; let us not then be so foolish as to employ all our Thoughts and bestow all our Time and Pains about cherishing, accommodating and gratifying our Bodies, in *making Provision for the Flesh to fulfil the Lusts thereof*, as the Apostle phraseth it, and suffer our Souls to lie by neglected in a miserable, and poor, and blind, and naked Condition. Some Philosophers will not allow the Body to be an essential Part of Man, but only the Vessel or Vehicle of the Soul; *Anima cujusque est quisque*; *the Soul is the Man.* Tho' I would not be so unequal to it, yet I must needs acknowledge it to be but an inferior Part; it is therefore so to be treated, so dieted and provided, as to render it most calm and compliant with the Soul, most tractable and obsequious to the Dictates of Reason; not so pamper'd and indulg'd, as to encourage it to cast its Rider, and to take the Reins into its own Hand, and usurp Dominion over the better Part, the τὸ ἡγεμονικὸν, to sink and depress it into a sordid Compliance with its own Lusts, *Atque affigere humi divinæ particulam auræ.*

This is our Duty; but alas! what is our Practice? Our great Partiality towards our Bodies, and Neglect of our Souls, shews clearly which Part we prefer; we are careful enough of wounding or maiming our Bodies, but we make bold to lash and wound our Souls daily; for every Sin we

we commit, being contrary to its Nature, is a real Stripe, yea, a mortal Wound to the Soul; and we shall find it to be so, if our Consciences be once awaken'd to feel the Sting and Smart of it. We are industrious enough to preserve our Bodies from Slavery and Thraldom, but we make nothing of suffering our Souls to be Slaves and Drudges to our Lusts, and to live in the vilest Bondage to the most degenerate of Creatures, the Devil. We are thrifty and provident enough, not to part with any thing that may be serviceable to our Bodies under a good Consideration, and we so esteem them as that we will part with all we have for the Life of them; but we make little Account of what is most beneficial to our Souls, the Means of Grace and Salvation, the Word of God, and Duties of his Worship and Service; nay, we can be content to sell our Souls themselves for a Trifle, for a thing of nothing, yea, for what is worse than nothing, the satisfying of an inordinate and unreasonable Appetite or Passion. We highly esteem and stand much upon our Nobility, our Birth and Breeding, tho' we derive nothing from our Ancestors but our Bodies and corporeal Qualities; and it is useful so far to value and improve this Advantage, as to provoke us to imitate the good Examples of our Progenitors, not to degenerate from them, nor to do any thing unworthy of our Breeding; and yet the divine Original of our Souls, which are Beams from the Father of Light, and the imme-

diate Off-spring of God himself, τοῦ γὰρ καὶ γένος ἐσμέν, hath little Influence upon us to engage us to walk worthily of our Extraction, and to do nothing that is base or ignoble, and unsuitable to the Dignity of our Birth.

You will say, how shall we manifest our Care of our Souls? What shall we do for them? I answer, the same we do for our Bodies.

First, We feed our Bodies, our Souls are also to be fed; the Food of the Soul is Knowledge, especially Knowledge in the Things of God, and the Things that concern its eternal Peace and Happiness; the Doctrine of Christianity, the Word of God read and preach'd, 1 *Pet.* ii. 2. *As new born Babes desire the sincere Milk of the Word, that ye may grow thereby*, Heb. v. 12. The Apostle speaks both of Milk and of strong Meat. Milk he there calls the Principles of the Doctrine of Christ. And again, 1 *Cor.* ii. 3. *I have fed you with Milk, and not with Meat; for hitherto ye were not able to bear it.* So we see in the Apostle's Phrase, feeding of the Flock, is teaching and instructing of them. Knowledge is the Foundation of Practice; it is impossible to do God's Will before we know it; the Word must be receiv'd into an honest and good Heart, and understood, before any Fruit can be brought forth.

Secondly,

Secondly, We heal and cure our Bodies, when they are inwardly ſick, or outwardly harm'd: Sin is the Sickneſs of the Soul. *Matth* ix. 12. *They that be whole need not a Phyſician, but they that be ſick*, ſaith our Saviour by way of Similitude; which he explains in the next Verſe, *I am not come to call the Righteous, but Sinners to Repentance.* For the Cure of this Diſeaſe, an humble, ſerious, hearty Repentance, is the only Phyſick; not to expiate the Guilt of it, but to qualify us to partake of the Benefit of that Atonement which our Saviour Chriſt hath made by the Sacrifice of himſelf, and reſtore us to the Favour of God, which we had forfeited, it being, as much as in us lies, an undoing again what we have done.

Thirdly, We cloath and adorn our Bodies; indeed too much Time and too many Thoughts we beſtow upon that; our Souls alſo are to be cloath'd with holy and virtuous Habits, and adorn'd with good Works. 1 *Pet.* v. 5. *Be ye cloath'd with Humility.* And in the ſame Epiſtle, *Chap.* ii. 2. he exhorts Women *to adorn themſelves, not with that outward adorning of plaiting the Hair, and wearing Gold*, &c. *but with the Ornament of a meek and quiet Spirit, which is in the Sight of God of great Price:* And

And in *Rev.* xix. 8. *The Righteouſneſs of the Saints* is call'd *fine Linen.* And the Saints are ſaid to be cloath'd in *white Raiment.* Matth. xxiii. 11. Works of Righteouſneſs and a Converſation becoming the Goſpel is call'd a *Wedding Garment. Coloſſ.* iii. 10. *Put on the new Man.* And again, *Put on therefore, as the Elect of God, Bowels of Mercy, Meekneſs,* &c. On the contrary, vicious Habits and ſinful Actions are compar'd to filthy Garments. So, *Zech.* iii. 3. *Joſhua* the High-Prieſt is ſaid to be *cloath'd with filthy Garments*; which in the next Verſe are interpreted his Iniquities, either perſonal, or of the People whom he repreſented: *I have cauſed thy Iniquity to paſs from thee, and will cloath thee with Change of Raiment.*

Fourthly, We arm and defend our Bodies, and our Souls have as much need of Armour as they; for the Life of a Chriſtian is a continual Warfare; and we have potent and vigilant Enemies to encounter withal, the Devil, the World, and this corrupt Fleſh we carry about us; we had need therefore to take to us the Chriſtian Panoply, to *put on the whole Armour of God, that we may withſtand in the evil day, and having done all, may ſtand; having our Loins girt with Truth, and having on the Breaſt-plate of Righteouſneſs, and our Feet ſhod with the Preparation of the Goſpel of Peace. Above all, taking the Shield of Faith; and for an Helmet, the Hope of Salvation, and the Sword of the Spirit, which is the Word of God*, Eph. vi. 13, 14.

He that with this Christian Armour manfully fights against and repels the Temptations and Assaults of his spiritual Enemies; he that keeps his Garments pure, and his Conscience void of Offence towards God and towards Man, shall enjoy perfect Peace here, and Assurance for ever. *Tacitus* saith of the *Finni*, a northern People, that they were *securi adversus homines, securi adversus Deos.* They need not fear what God or Man could do to them, because they were in as bad a Condition as could consist with living in the World; they could not be banish'd into a worse Country, nor put into worse Circumstances than they were in already. I might say of the Man that keeps a good Conscience, that he is secure against God and Man; not in that Sense the *Finni* were, but secure of any Evil befalling him from either. God can do him no Harm, not for want of Power, but for want of Will, which is regulated by his Truth and Justice. He is also secure in respect of Men, because he is under the Protection of the Almighty; and if any there be that would do him Harm, they shall either be restrain'd by the divine Providence, or if they be permitted to injure him, it shall tend only to the Exercise and Improvement of his Faith and Patience, and enhansing his future Reward at that great Day, when the Almighty shall dispense *Aureolæ* to those Champions who have signaliz'd their Valour and Fidelity by heroick Actions, or patient Sufferings of unworthy things for his sake.

3. A good Conscience not only secures a Man from

from God and Men, but from himself too; *there is no Peace to the Wicked, saith my God,* no inward Peace; such a Man is at odds with himself; for the Commandments of God being agreeable to the Nature of Man, and perfectly conformable to the Dictates of right Reason, Man's Judgment gives Sentence with the divine Law, and condemns him when he violates any of them; and so the Sinner becomes an *Heautontimorumenos*, a Tormentor of himself. *Prima est hæc ultio, quod se Judice nemo nocens absolvitur.* No guilty Person is absolv'd at his own Tribunal, himself being Judge.

Neither let any profligate Person, who hath bidden Defiance to his Conscience, and is at War with himself, think to take Sanctuary in Atheism, and because it imports him highly there should be no God, stoutly deny that there is any. For first, supposing that the Existence of a Deity were not demonstrably or infallibly prov'd (as it most certainly is) yet he cannot be sure of the contrary, that there is none. *For no Man can be sure of a* pure Negative, *namely, that such a thing is not, unless he will either pretend to have a certain Knowledge of all things that are or may be, than which nothing can be more monstrously and ridiculously arrogant; or else, unless he be sure that the being of what he denies doth imply a Contradiction, for which there is not the least Colour in this Case; the true Notion of God consisting in this,* that he is a Being of all possible Perfection, that I may borrow my Lord Bishop of *Chester*'s Words, in his Discourse of natural Religion, *Page* 94.

Now if he be not ſure there is no Deity, he cannot be without ſome Suſpicion and Fear that there may be one.

Secondly, *If there ſhould be a Deity, ſo holy, and juſt, and powerful, as is ſuppos'd, what Vengeance and Indignation may ſuch vile Miſcreants and Rebels expect, who have made it their Buſineſs to baniſh* him *out of the World, who is the great Creator and Governor of it; to undermine his Being, and eradicate all Notions of him out of their own and other Mens Minds; to provoke his Creatures and Vaſſals to a Contempt of him, a ſlighting of his Fear and Worſhip, as being ſuch imaginary* Chimæra's *as are fit only to keep Fools in awe? Certainly as this is the higheſt Provocation that any Man can be guilty of, ſo ſhall it be puniſh'd with the ſoreſt Vengeance.*

Now a ſlender Suſpicion of the Exiſtence of a Being, the Denial whereof is of ſo ſad Conſequence, muſt needs diſturb the Atheiſt's Thoughts, and fill him with Fears, and qualify and allay all his Pleaſures and Enjoyments, and render him miſerable even in this Life.

But on the other ſide, he that believes and owns a God, if there ſhould be none, is in no danger of any bad Conſequent; for all the Inconvenience of this Belief will be, that he may be hereby occaſion'd to tye himſelf up to ſome needleſs Reſtraints during this ſhort Time of his Life, wherein notwithſtanding

there is, as to the present, *much Peace, Quiet, and Safety; and as to the* future, *his Error shall die with him, there being none to call him to an Account for his Mistake.* Thus far the Bishop.

To which I shall add, that he not only suffers no Damage, but reaps a considerable Benefit from this Mistake; for during this Life he enjoys a pleasant Dream or Fancy of a future blessed State, with the Thoughts and Expectations whereof he solaces himself and agreeably entertains his Time, and is in no danger of being ever awaken'd out of it and convinc'd of his Error and Folly, Death making a full End of him.

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